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Forest Health Protection

Forest Health Technology  
Enterprise Team

FHTET 97-01

January 1997



# Forest Health Technology Enterprise Team

## Program of Work - FY 1997



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## EXECUTIVE SUMMARY

The two most significant long-term actions affecting the Team in 1997 will be the closure of FHTET-Davis and the elimination of locational references for the Enterprise Team to reflect our movement more completely into a team orientation. As a result of the closure, the focus areas of FHTET-Davis will not be lost however, but will continue to be addressed and reflected in the FHTET POW.

The FHTET program in FY 1997 will be concentrated into one internal (Management and Operations) and two external areas (Information Technology and Analysis, and Treatment Technology):

Specific work areas included under Information Technology and Analysis are: Data Acquisition; Information Analysis and Display; Information Management; Special Technology Development Program; Modeling; Quantitative Methods; Decision Support Systems, and; Information Distribution. These work areas encompass 23 separate emphasis items (20 continuing and 3 new) and involve cooperators from most Forest Service staffs, many other USDA agencies and other Departments, many universities, several foreign countries, virtually all States and private industry.

The Treatment Technology Program Area includes: Decision Support Systems for Pest Control; Environmental Fate Studies; the MTDC Forest Health Program; Biopesticides; Biological Controls; Non-Target Impacts; NAPIAP, and; Management of Pesticides. There are 11 new and 31 continuing emphasis items under this Program Area. As above, there are a number of cooperators working in these emphasis areas including the Forest Health units in all Forest Service Regions and the Northeastern Area, six Forest Service Experiment Stations, many other Forest Service staff areas, ARS, APHIS, four other Departments, private industry, 18 universities and 8 foreign countries.

The \$2,580,000 investment in technology development and improvements presented in this plan includes \$1,330,000 from the Enterprise Team and an additional \$1,250,000 contributed by collaborators and partners. (These numbers do NOT include management and operations activities nor do they include the \$722,000 NAPIAP project dollars or the "over-the-top" money that went to Engineering)





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## INTRODUCTION

### Foreword

The following is the proposed fiscal year 1997 (FY97) Program of Work for the Forest Health Technology Enterprise Team (FHTET). The tasks proposed here are based on the assumption that the FHTET funding level for FY97 will be the same as for FY96. If funding for FY97 is not equal to that of FY96, the scope of tasks described here will be reconsidered. Following are mission, vision, and goal statements for FHTET; projects described in this document are presented to support those statements.

### FHTET's Mission

To foster the development and use of technologies to protect  
and improve the health of America's forests.

### FHTET's Vision

FHTET is the forest health technology provider of choice because we are:

- responsive to customer needs,
- competent, and
- cost-competitive.

### FHTET's Goals

1. Forest health assessment technologies and information gathering, analysis and integration methods that are integral to forest ecosystem management are developed, evaluated, transferred to and used by land managers.
2. Environmentally sound technologies and application methodologies to maintain or improve the health of America's forests are developed, improved, evaluated, transferred to, and adopted by land managers.









PROJECT NO.: I.1.a

PROJECT NAME: FHTET Implementation

LEADER: Eav

LEADER ROLE: Conduct and coordinate.

PROJECT OBJECTIVE: To complete implementation of the Forest Health Technology Enterprise Team.

BACKGROUND/RATIONALE: On February 10, 1995, the Deputy Chief for State and Private Forestry, in the spirit of Forest Service Reinvention, chartered a Forest Health Technology Enterprise Team (FHTET) to deliver forest health technology services to Forest Service field units, State, and private partners in support of our land ethic, "promote the sustainability of ecosystems by ensuring their health, diversity, and productivity."

FHTET has two functions. The central (core) function consists of activities that support the Forest Service in meeting its legal mandate in the protection of forest health. The second, entrepreneurial, function will, with time, ensure that the team becomes a forest health technology service provider on a competitive and cost-reimbursable basis.

METHODS: The FHTET implementation plan details the process of fully implementing the Enterprise Team and its operating principles. Activities to be undertaken under direct leadership of FHTET Team Leader in fiscal year 1997 are listed below.

- Finalize FHTET strategic plan
- Expand entrepreneurial aspects of the Team
- Develop entrepreneurial-related marketing materials
- Expand and strengthen existing partnerships and establish new ones
- Refine the Team's role and negotiate agreements for administrative support in light of the Forest Service evolving administrative structure

**PRODUCTS AND DELIVERY DATES:**

FHTET Strategic Plan	December 1996
FHTET Capability Document	December 1996
Board of Directors Meeting	April 1997
FHTET Administrative Review	January 1997
FHTET 1997 Program of Work	October 1996
FHTET FY96 Accomplishment Report	October 1996

START/END DATES: FY96/FY97

COOPERATORS: WO FHP Staff; FHP Regional Directors.

**RESOURCE REQUIREMENTS:**

Eav	12 weeks
Bullard	4 weeks
Barry	2 weeks
Janiga	4 weeks



PROJECT NO.: I.1.b

PROJECT NAME: FHTET-FC Operations

LEADER: Eav

LEADER ROLE: Conduct and provide oversight.

PROJECT OBJECTIVES: To ensure the effective and efficient operation of FHTET-FC.

BACKGROUND/RATIONALE: The role of the Director is to provide leadership, overall direction and planning, and oversight in accomplishing the mission and goals of the unit.

METHODS: Work with the Washington Office (WO), Regional/Area Forest Health Protection (FHP), other FHTET directors and staffs, and the FHTET Steering Committee to establish the general direction for the unit. Develop long-term and annual programs of work in coordination with these, along with other Forest Service units and appropriate outside groups, such as APHIS, ARS, USFWS, EPA, state agencies, industry, university scientists, public interest groups, and governmental agencies of foreign countries. The technical projects in the Program of Work will be carried out by the FHTET-FC staff and cooperators with the assistance, coordination, and oversight of the FHTET-FC Director and staff.

PRODUCTS AND DELIVERY DATES:

FHTET-FC's input to 1996 Accomplishment Report	October 1996
FHTET-FC's input to 1998 POW	September 1997

START/END DATES: October 1996-September 1997

COOPERATORS:

WO FHP Staff; FHP Regional Directors.

RESOURCE REQUIREMENTS (FHTET-FC)

Eav	24 weeks
Adams	2 weeks
Haynes	30 weeks
Janiga	6 weeks
Means	46 weeks
Myhre	2 weeks
Pywell	6 weeks
Roschke	2 weeks
Scrivner	4 weeks
Smith	2 weeks
Williams	2 weeks

PROJECT NO: I.1.c

PROJECT NAME: FHTET-Morgantown Operations

LEADER: Bullard

LEADER ROLE: Conduct and provide oversight.

OBJECTIVES: To define and maintain FHTET-Morgantown scope and operations.

BACKGROUND/RATIONALE: The role of the Director is to provide leadership, overall direction, planning, and oversight in accomplishing the mission and goals of the unit.

METHODS: Work with the WO, Regional/Area FHP, other FHTET directors and staffs, and the FHTET Steering Committee to establish the general direction for the Morgantown unit. Long-term and annual programs of Work will be developed in coordination with these groups along with other Forest Service units and appropriate outside groups such as APHIS, ARS, USFWS, EPA, USDA, state agencies, industry, university scientists, public interest groups and governmental agencies of foreign countries. The technical projects in the Program of Work will be carried out by cooperators and collaborators with the assistance, coordination and oversight of the FHTET-M Director and staff.

PRODUCTS/DELIVERY DATES:

FHTET-M inputs to the FY96 Accomplishment Report	October 1996
FHTET-M inputs to the Draft/final FY 1997 POW	August/October 1996
Review Morgantown staffing, adjust as needed	Continuing
Develop FY97 and proposed FY98 FHTET-M budgets	August 1996/January 1997
FHTET-M inputs to the FHTET Strategic Plan	December 1996
Coordinate with Team Leader on FHTET operations	Continuing
FHTET-M inputs to the Draft FY98 POW	August 1997

START/END DATES: Ongoing

COOPERATORS: FHP-WO Director and Staff; FHP Regional/Area Directors.

RESOURCE REQUIREMENTS:

Bullard	24 weeks
Cress	42 weeks
Reardon	4 weeks
Stein	4 weeks

PROJECT NO.: I.1.d

PROJECT NAME: FHTET-Davis Closure

LEADER: Barry

LEADER ROLE: Conduct.

PROJECT OBJECTIVE: To maintain FHTET-Davis operations and productivity until January 3, 1997, and to close the FHTET-Davis office by January 3, 1997.

BACKGROUND/RATIONALE: Director, FHP, following recommendation of the FHTET leadership, has decided to close the FHTET-Davis office and integrate its program with FHTET-Fort Collins and FHTET-Morgantown.

METHODS: Manage FHTET-Davis and the MTDC/FHP program through the 1st quarter FY97 and complete office closure. An office closure plan was submitted to the Director, Forest Health Protection, and FHTET leadership on August 20, 1996. Actions, schedules of events, and responsibilities have been detailed in the plan.

PRODUCTS AND DELIVERY DATES:

Budget	August 1996
Closure Plan submitted	August 1996
Closure Plan concurrence	September 1996
Office Closure	January 1997
FY97 (1 <sup>st</sup> Qtr) Program of Work tasks	January 1997

START/END DATES: October 1996/January 1997

COOPERATORS: Ann Bartuska, Bov Eav, Allan Bullard.

RESOURCE REQUIREMENTS:

Barry	9 weeks
Skyler	9 weeks
Whitmire	9 weeks



PROJECT NO.: I.2.a

PROJECT NAME: FHTET Communications

LEADER: Janiga

LEADER ROLE: Conduct.

PROJECT OBJECTIVES: To communicate to other Forest Service units and units in other agencies the benefits an enterprise team approach provides in technology development and the benefits of those technologies in realizing forest health objectives.

BACKGROUND/RATIONALE: FHTET needs to efficiently communicate key messages about our group; foster active dialog with sponsors, customers, and partners; and appraise the fit between clients needs and Enterprise Team products and services. The Enterprise Team maintains a communications plan as the backbone for setting objectives for a variety of communications activities. Tasks under this project are primarily an aggregation of tasks assigned to several teams. Production and dissemination of materials will be coordinated across all FHTET sites and project teams, and will include preparation of materials for dissemination through electronic networks.

PRODUCTS AND DELIVERY DATES:

1. Forest Health Technology Enterprise Team Updates: quarterly
2. General FHTET information materials: February 1997
3. Revised FHTET Communications Plan: ongoing
4. Forest Health display and general FHTET display maintenance and presentation: ongoing
5. Customer Outreach Plan and annual revision: March 1997
6. FHTET annual meeting agenda and support materials: July 1997
7. Synopsis of marketing activities by project teams (internal): quarterly
8. Assessment of marketing effectiveness (internal): ongoing
9. ET promotional brochures and capability descriptions: ongoing
10. ET general poster and/or display maintenance and presentation: ongoing
11. Other FHTET communications materials, as identified in the FHTET Communications Plan: ongoing

START/END DATES: Ongoing

COOPERATORS: None.

RESOURCE REQUIREMENTS:

Janiga	10 Weeks	Eav	3 weeks
Adams	3 weeks	Haynes	1 week
Scrivner	28 weeks	Skyler	3 weeks
Reardon	5 weeks	Smith	3 weeks
Roschke	3 weeks	Means	1 week
Cress	1 week		

PROJECT NO.: I.3.a

PROJECT NAME: Computer Systems Support

LEADER: Roschke

LEADER ROLE: Coordinate and conduct.

**PROJECT OBJECTIVES:** Provide systems support for FHTET-FC computer equipment and local area network, including maintaining and providing support for IBM contract equipment, other workstations, Macintoshes, PCs, printers, backups, and hardware and software tracking, purchasing, and updating.

Provide access to IBM contract systems to all FHTET-FC federal and contract staff through x-terminals or x-terminal emulation on other systems such as PCs and Macs. Transition all work to the new platform to the extent feasible--including, for example, word processing and document development, filing, and e-mail.

**BACKGROUND/RATIONALE:** FHTET-FC uses a variety of networked computer systems, equipment, and software in an increasingly complex computing environment. Maintaining, enhancing, and tracking these systems is often complex and time-consuming. Some of these tasks can be more efficiently handled through centralized support.

The contract for the new Forest Service computing platform was awarded to IBM in late FY95. FHTET received its first new equipment from the contract in early FY96. A pilot year for testing the new equipment was requested by Congress; this pilot year lasted through July of 1996. Access to the Forest Service wide area network (WAN) should be in place during the first quarter of FY97.

During the pilot year, we experienced continuing problems and growing pains with the new systems. Its unreliability and lack of a connection to the rest of the Forest Service made it inadequate for production work, and it was used only sporadically for testing and to gain some familiarity with the system; little production work was attempted on the system and there was little need for regular access. This should change in FY97, as the products improve, FS WAN access is established, and experience gained by systems administration personnel during the pilot year allow for a more reliable system. The software tools available on the IBM platform are far more powerful than those offered on the DG. FHTET needs to take advantage of the new systems in preparation for the time that the DG is removed, and in order to stay abreast with or ahead of the rest of the FS in the adoption of this new technology.

**PRODUCTS AND DELIVERY DATES:**

Access to the IBM system for all FHTET-FC federal and contract staff.

Delivery data: September 1997

**START/END DATES:** Ongoing

**COOPERATORS:** None

**RESOURCE REQUIREMENTS:**

Roschke	12 weeks
Scrivner	8 weeks

## II. INFORMATION TECHNOLOGY AND ANALYSIS

PROJECT NO: II.1.a

PROJECT NAME: Airborne/Spaceborne Sensor Evaluation and Development

LEADER: Pywell

LEADER ROLE: Conduct, Cooperate, and Coordinate.

**PROJECT OBJECTIVE:** In cooperation with Regions/Area and the Remote Sensing Applications Center (RSAC), evaluate new sensor technologies (such as digital imaging and photographic systems), new satellite systems, digital sketchmapping, GPS, moving map display systems, and image processing techniques for potential application to forest health detection surveys and monitoring.

**BACKGROUND/RATIONALE:** These evaluations serve three purposes: (1) collect information on spectral and spatial characteristics of specific insect/pathogen/host type combinations, (2) evaluate existing sensor technology for possible incorporation into ongoing aerial survey and forest health monitoring programs, and (3) gain needed information for making recommendations for future airborne and spaceborne sensor development. Through this task, RSAC will provide technical support to Forest Health Protection. This work will be done in cooperation with FHP field units and coordinated by FHTET. RSAC work will involve evaluating and developing remote sensing technology for field-level forest health applications, providing information to upper management on trends and directions of new remote sensing technology applicable to forest health, and providing on-going field support where appropriate.

**METHODS:** The approach will be to select several groupings of stressors (i.e., bark beetles, conifer or hardwood defoliators, root diseases, etc.) for the evaluations. Operationally, new sensors will be installed in an aircraft with existing technology, such as a color video camera and/or aerial camera systems. This will enable comparison between existing sensor imagery and the test systems. In the case of satellite-based systems, suitable aerial photography and/or field data will be acquired for comparison. Image interpretation and analysis will be completed cooperatively by RSAC, FHTET, and FHP field staff. Technology evaluation and development work will include such items as improved sketchmapping equipment, refinement of the color infrared digital camera system, digital video, applications for accuracy assessments and sampling, and new image processing software for georeferencing and mosaicking digital imagery.

RSAC and FHTET will coordinate and exchange information on remote sensing technology evaluation and development efforts with other agencies, such as NASA, DoE, and DoD, universities and private companies. New developments in remote sensing technology, advanced image processing and GIS systems will be reviewed for potential FHP applications.

Information to upper management will include briefings and other supplemental materials about trends in development of applicable remote sensing technology. The equipment and devices evaluated in this area may include units that are not field-proven or commercially-available; it is important, however, for the agency to recognize and be able to respond to new opportunities that may realistically arise from use of this technology. To the extent possible, an evaluation of the



potential application of advanced classified sensors to forest health monitoring will be conducted.

**PRODUCTS AND DELIVERY DATES:**

Evaluation report (color infra-red digital camera)	December 1996
Image acquisition (digital imaging systems)	August 1997
Image interpretation (digital imaging systems)	October 1997
Evaluation report (digital video & frame camera)	December 1997
Digital sketchmap report	September 1997
Improved automosaic capability	September 1997
Manti-LaSal subpixel analysis evaluation	March 1997

**START/END DATES:** December 1997

**COOPERATORS:** RSAC (Greenfield, Lachowski), Region 1 (McConnell), Region 2 (E.Johnson), Region 4 (Knapp, Munson), Region 5 (Levien), Region 6 (Bridgewater), Region 8 (Spriggs), Northeastern Area (Frament, Omer), Manti-LaSal National Forest (Cote), NZ-FRI (Hosking).

**RESOURCE REQUIREMENTS:**

Myhre	8 weeks
Pywell	4 weeks
Funding	\$41,482 (FHTET)
	\$105,000 (RSAC)



PROJECT NO: II.1.b

PROJECT NAME: Remote Sensing Support for Acquisition of Imagery

LEADER: Myhre

LEADER ROLE: Conduct and coordinate

**PROJECT OBJECTIVE:** Provide services and support to the field for acquisition of remotely sensed data in support of forest health monitoring programs and other resources activities. The Remote Sensing Services Team (RSST), FHTET-Ft. Collins will maintain a program of remote sensing acquisition and support utilizing the FS Beechcraft King Air, plus provide an aerial platform (King Air) for developmental/test flights for evaluation of new sensor technologies.

Remote Sensing Applications Center (RSAC) will provide support to acquire satellite imagery, high altitude aerial photography (9x9, large-format camera or optical bar) and other airborne digital imagery as needed by FHP staffs. High altitude aerial photography and digital imagery will be acquired through Forest Service participation with the NASA ER-2 High Altitude Program. Other sources for airborne imagery, such as DoE, DoD, other agencies and private companies will be utilized as needed to support special project needs.

**BACKGROUND/RATIONALE:** The remote sensing service and support activity has been in effect for a number of years within FHP/FHTET (formerly FPM/MAG). The program provides an aerial platform for development and testing of new remote sensing systems and techniques, and provides an image acquisition service for the field in support of pest management detection and monitoring surveys. With the growing interest and demand for remote sensing in Forest Health Monitoring, need for this service and support capabilities is bound to increase.

**METHODS:** RSST will work with customers/users requesting support by helping to determine their needs, providing remote sensing consultation, and designing an airborne mission plan for acquisition of aerial photography or airborne videography. A total service package, including mission cost estimate and planning, acquisition of imagery, purchasing and processing of film, preparing index maps, and delivery of end products, will be provided to the user. RSST operation costs (aircraft, pilot/photographer salaries, per diem, and film and film processing costs) will be covered by the customer.

RSAC will coordinate the acquisition of satellite and special aerial photography and airborne digital imagery with NASA, other agencies and private firms. RSAC will also provide support in photo interpretation and analysis as needed for FHP field projects.

**PRODUCTS AND DELIVERY DATES:**

Meet with R2 Fiscal and Aviation Management to finalize operating costs of aircraft.	November 1996
Establish a special RSST account for receiving funds from users and paying operating expenses	November 1996
Mission flight schedule for summer 1997	May 1997
Mission planning, transferring funds, conducting airborne operations	Ongoing
Missions completed and products delivered	September 1997
Acquisition of satellite or special imagery (RSAC)	Ongoing

Special project support in aerial photography  
interpretation and analysis (RSAC)

Ongoing

START/END DATES: Ongoing

COOPERATORS: R2 Fiscal and Aviation Management; Rocky Mt. Sta. Budget and Finance; customers from F.S. units or other agencies; and RSAC.

RESOURCE REQUIREMENTS:

Myhre	15 weeks
Funding	\$21,724 (FHTET)
	\$89,000 (external funds from customers)
	\$35,000 (RSAC)

PROJECT NO: II.1.c

PROJECT NAME: Remote Sensing Technology Transfer, Training, and Support

LEADER: Myhre

LEADER ROLE: Conduct and cooperate.

PROJECT OBJECTIVE: Provide a series of training courses and technology transfer activities on remote sensing technologies to FHP personnel. These training courses will be designed to improve current operational techniques and to enhance job skills of field personnel. Provide technical assistance and support to FHP units.

BACKGROUND/RATIONALE: The need for additional training has been expressed by a number of FHP field units and personnel. To meet these needs, training courses will be planned and conducted in FY97. With input from FHP field personnel, course curricula will be designed to meet their training needs and objectives.

The WO Engineering, Remote Sensing Applications Center (RSAC) will provide technical support and assistance to FHTET in Fort Collins. RSAC will provide training, in cooperation with FHTET Fort Collins, to FHP staffs in the use of remote sensing, GPS, and related technologies. Training will feature practical applications of remote sensing technology to assist FHP field staffs complete forest pest detection and monitoring work efficiently. Applications of existing remote sensing technology and new emerging technologies will be addressed. The results of RSAC and FHTET remote sensing technology evaluation and development efforts will be also be included.

#### METHODS:

##### TRAINING ACTIVITIES:

The approach will be to develop training curricula, prepare training materials, and conduct the training courses. The following courses will be conducted:

1. "Integrating Remote Sensing Into Operational Pest Detection and Monitoring Programs" - This course will cover available remote sensing tools and related technologies, and how they may be integrated into FHP's aerial survey programs. This will be a cooperative effort with RSAC, FHTET and various FHP field units.
2. "Automated Digital Mosaicking of Video" - This course will provide hands-on training to FHP units who have the Airborne Video System and wish to update their system with the new automated mosaicking modifications. The course will cover the installation and use of new components to the airborne system, and video image processing using the new Airborne Video Toolkit software.
3. Other training as requested - A questionnaire and list of available courses will be sent out in October 1996 to all FHP field units requesting feedback on their training needs for FY97. Existing RSAC training courses include: basic and advanced aerial photography interpretation, digital image processing, cartography for GIS users, and GPS. Other application-specific training can be developed as



needed. Based on the responses from the field, a training action plan will be developed by FHTET and RSAC.

#### RSAC ACTION ITEMS:

1. Continue to support the color infra-red (CIR) digital camera technology work by providing training with camera use and image processing, as well as recommendations for use and improvements as these become available.
2. In cooperation with FHTET, develop the FHP training action plan based on input received from the 1996 survey. Coordinate with FHTET as to the number and types of courses to be offered this fiscal year.
3. Conduct training courses for FHP personnel according to action plan.
4. Coordinate with Patrice Janiga for the March 1997 MIR Steering Committee Meeting to be held in Salt Lake City.
5. Perform other remote sensing assistance as mutually agreed upon between the project sponsor and RSAC.

#### PRODUCTS AND DELIVERY DATES:

FHP training action plan	November 1996
"Integrating R.S. Into Operational Programs"	February 1997
RSAC-coordinated MIR meeting (w/P.Janiga)	March 1997
Automated Digital Mosaicking of Video course	as requested in FY97
Other training courses	to be determined
Provide CIR digital camera support and training	as requested in FY97

#### START/END DATES: Ongoing

COOPERATORS: Jule Caylor (RSAC Training & Tech. Transfer Program); Paul Greenfield (RSAC Liaison & Special Project Program); and various FHP field units.

#### RESOURCE REQUIREMENTS:

Myhre	8 weeks
Funding	\$15,956 (FHTET)
	\$15,000 (RSAC)

PROJECT NO.: DII.1.d

PROJECT NAME: DFTM Trap Manufacture and Distribution

LEADER: Scrivner

LEADER ROLE: Conduct, coordinate, and provide oversight.

PROJECT OBJECTIVE: To coordinate the manufacture and distribution of pheromone traps to western Regions and State cooperators in support of the Douglas-fir tussock moth early warning detection system.

BACKGROUND/RATIONALE: FHTET-FC contracts each year with the Foothills Gateway Rehabilitation Center in Fort Collins, Colorado, for the manufacture of Douglas-fir tussock moth pheromone traps. These traps help determine outbreak potential by capturing male tussock moths during the mating season. The number of moths caught is an indication of the number of larvae that will be present the following spring and the subsequent potential for defoliation.

METHODS: FHTET-FC sends a letter to the FHP Directors of Regions 1-6 in January, asking that their FHP staffs to contact the cooperating States in the Region and submit a consolidated order for pheromone traps to FHTET-FC. FHTET-FC then orders the following materials for the traps: flat milk cartons, Tangle Trap (a sticky adhesive that traps the moths attracted by the pheromone), twist ties (used for hanging the traps), and pheromone. The pheromone is manufactured by Phero Tech Inc., a Canadian company that manufactures insect management products; Phero Tech has coordinated its development of the pheromone with the Forestry Sciences Lab in Corvallis, Oregon. Foothills Gateway picks up the milk cartons and Tangle Trap and manufactures, packs, and ships the traps. FHTET-FC then sends the pheromone, twist ties, and survey forms to field units.

PRODUCTS AND DELIVERY DATES:

Traps (approx. 7,000) sent to field units

June 1997

START/END DATES: Ongoing

COOPERATORS: Regions 1-6 and States in these Regions.

RESOURCE REQUIREMENTS (FHTET-FC):

Scrivner 6 weeks

Funding \$16,900 (FHTET)

PROJECT NO: II.2.a

PROJECT NAME: Support for National Reporting Requirements

LEADER: Pywell

LEADER ROLE: Cooperate.

**PROJECT OBJECTIVE:** Provide data base development and data management support to the FHP-WO, including: requesting data from field units; data entry, verification, and summary; map preparation; and data analysis and interpretation to meet national reporting requirements on forest health conditions, trends, and management.

**BACKGROUND/RATIONALE:** FHP-WO has a number of data reporting requirements that require the collection, synthesis, and presentation of forest health conditions, trends and management activities across the U.S., both for a single year and for the monitoring of trends over time. Many of these requirements rely on data collected by FHP field units. This task will result in products which can be used by the Washington and Regional Offices to present to the Administration, Congress, and the public the status of forest health concerns and management activities.

**METHODS:** Data used will be solicited from the Regions, states, Research, and other sources. In almost all cases, these data are already being collected and reported to the Washington Office. In cases where the data is not available in a digital form, the data conversion will be performed through FHTET-FC. National GIS databases will then be constructed as appropriate. The following tasks/products are anticipated:

- Continue work on a map and digital database showing insect and disease risk in cooperation with the WO-Insect and Disease Risk Map Team and the Regions/Area. FHTET will be responsible for: facilitating a meeting of Regional representatives; digitizing revised data for Region 5, Region 6, and NA; revising the national database; and producing a variety of hardcopy products.
- A digital and hardcopy map showing FHP activities on other federal lands in FY 1996 will be produced. FHTET will be responsible for soliciting the necessary data from the Regions/Area, building the database, and producing the final map.
- Develop national map overlays and GIS data base showing the extent of major exotic forest insects and diseases.
- Develop a national map and GIS database showing forested areas at high risk to photochemical oxidants.
- Develop a national map and GIS database showing the National Forests and other Federal lands where suppression, prevention, and eradication projects were carried out in FY 1996. FHTET will be responsible for digitizing the data if required, building the database, and producing the final map based on data supplied by WO.
- Produce tables and maps for the 1996 I&D Conditions Report.



**PRODUCTS AND DELIVERY DATES:**

Map of FHP activities on other federal lands	March 1997
Map of suppression, prevention, and eradication projects	March 1997
I&D national risk map	April 1997
Map of exotic forest insects and diseases	September 1997
Map of air pollution effects	September 1997

**START/END DATES:** Ongoing

**COOPERATORS:** FHP-WO (Weiss, Lewis), Regions/Area

**RESOURCE REQUIREMENTS (FHTET-FC):**

Pywell	5 weeks
Funding	\$43,860 (FHTET)

PROJECT NO: II.2.b

PROJECT NAME: Support for Off-Plot Forest Health Monitoring

LEADER: Pywell

LEADER ROLE: Cooperate.

**PROJECT OBJECTIVE:** Provide database development and data management support to the FHP-WO for Forest Health Monitoring, including requesting data from field units; data entry, verification, and summary; map preparation; and data analysis and interpretation to meet national reporting requirements on forest health conditions and trends.

**BACKGROUND/RATIONALE:** FHP-WO has a number of data reporting requirements that require the collection, analysis, and synthesis of insect and disease occurrence across the U.S., both for a single year and for the monitoring of trends over time. Many of these requirements rely on data from aerial pest detection surveys conducted by FHP field units and state cooperators. This task will result in a process for developing and maintaining a national database of aerial survey data in a digital form which will improve our ability to provide reports, maps and responses to adhoc queries about insect and disease occurrence and trends in the U.S. It should also contribute to standardization of data collection and coding procedures between Regions.

**METHODS:** Data used will be from the Regions' routine aerial survey activities. As most Regions currently digitize this data, it will be collected in a digital form. In cases where it has not been digitized, the data conversion will be performed through FHTET. A national GIS database will then be constructed. Initially, the data will be stored in a single database at FHTET. However, as Project 615 technology comes on line, we will explore options for developing and maintaining a distributed database, with the data residing at the points of collection but available to all users across the country. As time permits, historic data will be incorporated into the database so that trends can be analyzed. Incorporation of other "off-frame" and plot data will be evaluated.

During early FY97, an analysis and report will be completed, comparing the similarities and differences in data collection methods, content, and coding of aerial survey data between Regions. This analysis will be based on FY95 aerial survey data. The results of this analysis will be presented at the annual Forest Health Monitoring meeting in January 1997. Feedback from WO/Regional/State FHM representatives will be requested. This feedback will then be presented at a meeting of FHP Regional GIS and Aerial Survey Coordinators in late winter. This group will be asked to develop recommendations for national data and coding standards for aerial survey data.

Other FY97 activities will include conducting a pilot test in Region 4 to determine the feasibility of, and develop methods to, relate plot data to aerial survey data.

**PRODUCTS AND DELIVERY DATES:**

Database for all Regions of 1995 survey data	September 1996
GIS/aerial survey meeting	November 1996
Report on inter-Regional differences	December 1996
R4 pilot test report	December 1996
Evaluation report of 5,000 acre standard	December 1996
Database for all Regions of 1996 survey data	January 1997
Recommended data collection and coding standards	April 1997
Procedures for producing data for WO reporting requirements	September 1997

**START/END DATES:** Ongoing

**COOPERATORS:** FHP-WO (Weiss, Mangold), FHP-Regions/Area, FHM-RTP (Loomis), FHM Coordinators.

**RESOURCE REQUIREMENTS (FHTET-FC):**

Pywell	14 weeks
Smith	2 weeks
Funding	\$26,531 (FHTET)



PROJECT NO: II.2.c

PROJECT NAME: GIS/Remote Sensing/Data Visualization Applications Support

LEADER: Pywell

LEADER ROLE: Cooperate.

PROJECT OBJECTIVE: Through the facilities of the Advanced Technology Lab, provide training, support, and leadership to FHTET, FHP field units, and domestic and international cooperators in the evaluation, use, and application of remote sensing, image processing, data visualization, and GIS technologies. Act as GIS Coordinator for the Washington Office Detached Units in Fort Collins.

BACKGROUND/RATIONALE: As Project 615 is implemented over the next several years, many advanced analytical tools will be available to FHP field units. The success of this implementation will depend, to a large degree, on having field personnel experienced in the use of these tools. One of the tasks of the FHTET's Advanced Technology Lab will be to work with field units on cooperative projects to evaluate advanced technology tools, determine how these tools can best be applied to FHP problems, and to train field personnel in the use and application of these tools. Tasks will include cooperative projects and training in GIS, the Airborne Video Toolkit, image processing, digital camera operation, SmartForest, and other tools. FHTET will also continue to operate and maintain the GPS Community Base Station in cooperation with Region 2.

METHODS: Short-term projects, technical assistance, training sessions and technology development projects through cooperative special project funding will be used.

PRODUCTS AND DELIVERY DATES:

Support to field units in technology applications	September 1997
Technology evaluation and application reports, papers, journal articles and improved awareness.	September 1997

START/END DATES: Ongoing

COOPERATORS: FHP field units, RSAC, Regions/Area, vendors, universities, and international cooperators.

RESOURCE REQUIREMENTS (FHTET):

Pywell	6 weeks
Myhre	2 weeks
Funding	\$47,868 (FHTET)

PROJECT NO: II.2.d

PROJECT NAME: Pest Model Output Display

LEADER: Pywell

LEADER ROLE: Cooperate.

**PROJECT OBJECTIVE:** In cooperation with FHP Regions, Timber Management Service Center, Intermountain Station, Missoula Fire Lab, Pacific Northwest Station, and the University of Illinois, continue development of a visual output component for forest insect and disease models which will allow the display of pest impacts, forest fuels, and forest management alternatives, and develop an interface of these capabilities to ARCView, INFORMS, and the Forest Vegetation Simulator (FVS).

**BACKGROUND/RATIONALE:** Data visualization techniques have proven valuable in displaying possible future forest conditions to both resource managers and stakeholders. Through these techniques, stand data, model outputs, and management actions can be displayed in a meaningful way. FHP has invested considerably in the development of this technology. FHP field personnel and regional staffs are working with PNW to use stand visualization graphics driven by the Forest Vegetation Simulator. Through this task, development will continue while other partners are recruited to assist in the continued development and implementation of this technology.

**METHODS:** Integration of the SmartForest visualization software with FVS and INFORMS will be continued through a cooperative agreement with the University of Illinois. Problems identified with moving SmartForest to the Project 615 platform during FY96 will be resolved. Installation of SmartForest on the Dixie National Forest will be completed. Through meetings, papers, and demonstrations, attempts will be made to garner support for the continued development and application of this technology. The effects of insects and diseases simulated by pest models will be depicted by including them in Stand Visualization System software (a PNW product) and implementing this depiction within INFORMS, SUPPOSE, and other relevant FHP systems.

**PRODUCTS AND DELIVERY DATES:**

Port SmartForest to 615 platform at FHTET	September 1996
Implement SmartForest using Mesa Graphics Library	December 1996
Install SmartForest at Dixie National Forest	January 1997
Evaluation report of feasibility of running in an Xterminal environment	March 1997
Evaluation report of feasibility of porting to an Intel/PC environment running Windows-95 or -NT	May 1997
Dixie evaluation report	September 1997
Integration with user interface	September 1997
Coordination for stand-level effects with FVS and pest ext.	Ongoing

**START/END DATES:** Ongoing

**COOPERATORS:** University of Illinois (Orland), TMSC (Johnson, Teck), Intermountain Station (Crookston), WO-Timber (Wells), Region 4 (Munson), Dixie National Forest (Ferguson), PNW (McGaughey), Region 6 (Gregg).

RESOURCE REQUIREMENTS (FHTET):

Pywell	5 weeks
Janiga	5 weeks
Roschke	3 weeks
Adams	1 weeks
Funding	\$32,616 (FHTET)



PROJECT NO.: II.3.a

PROJECT NAME: Support for Forest Health Projects and Display

LEADER: Janiga

LEADER ROLE: Coordinate.

PROJECT OBJECTIVE: This task provides support for communications objectives related to the Western Forest Health Initiative and the Forest Health Exhibit display.

BACKGROUND/RATIONALE: The Western Forest Health Initiative was started in fiscal year 1995 in order to identify key projects occurring throughout the West that contribute to site restoration, minimize the hazard of loss of ecological processes, and/or restore or substitute for ecological processes. This Initiative contributes to communications objectives for all forest health programs. Tracking of project progress is conducted by Forest Health Coordinators with support from the Enterprise Team. Work conducted under this project provides data acquisition, storage, management, and reporting support for the Western Forest Health Initiative and the coordination for the Forest Health Display. Most work requires skills in database management systems, editing, and coordination in order to exchange information and schedule commitments with Forest Health Coordinators and the Washington Office. Additionally, the Enterprise Team, as a service to national Forest Health Protection programs coordinates the use of the Forest Health Display. All conference registrations, booth fees, and similar logistics are managed and paid for in support of national program use of the display. The scheduling for use by Region/Area or State offices is also conducted through this project.

PRODUCTS AND DELIVERY DATES:

1. Databases and data management services for the Western Forest Health Initiative: ongoing
2. Coordination of the Forest Health exhibit for four national conferences and other meetings as requested by regional coordinators: ongoing

START/END DATES: Ongoing

COOPERATORS: Regional Forest Health Coordinators.

RESOURCE REQUIREMENTS:

Janiga	5 weeks
Funding	\$8,073 (FHTET)

PROJECT NO: II.3.b

PROJECT NAME: PTIPS Database Support

LEADER: Adams

LEADER ROLE: Conduct and cooperate.

PROJECT OBJECTIVE: To maintain the PTIPS database for use by Regions, National Forests, and Ranger Districts for generating reports on current and projected states of the forest.

BACKGROUND/RATIONALE: The Pest Trend Impact Plot System (PTIPS) database is supported by FHTET-FC. This service includes consulting with the users, making necessary changes to the database, developing new software, and providing documentation. Software development includes loader programs, statistical reports, and other identified enhancements. The PTIPS/ALLVEG merged structure will be provided to the Regions, along with updated documentation. The data presently residing within the database will be converted to the new structure. Conversion to 615 platform will be the main emphasis for this year.

PRODUCTS AND DELIVERY DATES:

- Statistical reports
- PTIPS on 615
- PTIPS update
- PTIPS User's Guide update

START/END DATES: Ongoing

COOPERATORS: Sue Hagle (FHP, R1), Nancy Campbell (FHP, R1), Pete Angwin (FHP, R2), Jeri Lynn Harris (FHP, R2), Terry Rogers (FHP, R3), Borys Tkacz, Project Manager (FHP, R3), Mary Lou Fairweather (FHP, R3), John Guyon (FHP, R4), Susan Frankel (FHP, R4), Ellen Goheen, (FHP, R6), Bruce Hostetler (FHP, R6), Paul Hennon (FHP, R10).

RESOURCE REQUIREMENTS:

Adams	4 weeks
Funding	\$49,388 (WO-FHP to FHTET)
	\$50,000 (from external TDP sources)

PROJECT NO.: II.3.c

PROJECT NAME: PURS Database Support and Report

LEADER: Roschke

LEADER ROLE: Coordinate and conduct.

PROJECT OBJECTIVE: Collect and manage pesticide use data from the Regions and Area; prepare the Pesticide Use Report for inclusion in the Annual Report of the Forest Service; transfer the database from a non-contract Sun workstation to the IBM/615 system.

BACKGROUND/RATIONALE: One of the tables included in the annual "Report of the Forest Service" is a summary report of pesticide use on National Forest lands, listing the active ingredients, the target pest or purpose, the quantities used, and the units treated for each pesticide. An Oracle database application has been developed at FHTET-FC and used for the last few years to manage the data and produce the report; its transfer to Oracle on the corporate platform will open the door for increased access to and use of the data by WO-FHP and other FS personnel.

PRODUCTS AND DELIVERY DATES:

PURS database converted and moved to IBM platform	November 1996
FY96 data entered and verified	December 1996
Pesticide use report for Annual Report of the Forest Service	Jan. 1996
Call letter to R/S/A	September 1997

START/END DATES: Ongoing

COOPERATORS: Dave Atkins (R1); Susan Johnson (R2); Doug Parker (R3); Dave Baumgartner (R4); Randall Godden (R5); Gary Smith (R6); Paul Mistretta (R8); Russell McKinney (R9); Ed Holsten (R10).

RESOURCE REQUIREMENTS:

Roschke	4 weeks
Jack Stein	3 weeks
Scrivner	4 weeks
Jesus Cota	1 week
Funding	\$6,532 (FHTET)



PROJECT NO.: II.3.d

PROJECT NAME: NAPIAP Database Support

LEADER: Adams

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVE: To provide a database for NAPIAP on 615 platform.

BACKGROUND/RATIONALE: NAPIAP database was developed several years ago to meet the needs of the program at that time. Since then several changes have transformed the program and the requirements met by the database.

METHODS: An analysis of the Financial Management and Information Systems (FMIS) developed by the Northeast Station will be conducted to compare the requirements of NAPIAP to this system. FMIS is currently in use by the Rocky Mountain Station for tracking grants and agreements and has been nationally approved.

Upon completion of the analysis, the FMIS database will be ported from the Data General system at RMS to the 615 platform. Modifications will be made on 615 to accommodate NAPIAP data requirements. If the analysis finds that FMIS and NAPIAP requirements are not compatible, then either another database will be reviewed or a new system will be designed and developed.

Data collected will be loaded into the existing system and transferred to the new database when it is in production. Assistance and support will be provided to NAPIAP users for querying and retrieving information from the existing database.

**PRODUCTS AND DELIVERY DATES:**

Analysis of FMIS	September 1997
Data loaded	September 1997
New system in production on 615	September 1997

START/END DATES: Maintenance and support are ongoing, analysis and development end in 1997.

COOPERATORS: Gary Smith (R6 FHP/detailed to Morgantown).

**RESOURCE REQUIREMENTS:**

Adams	2 weeks
Janiga	1 week
Funding	\$12,295 (FHTET)

PROJECT NO.: II.4.a

PROJECT NAME: Technology Development Program Support

LEADER: Janiga

LEADER ROLE: Coordinate.

**PROJECT OBJECTIVES:** To coordinate the review and administration of Technology Development Program projects; manage operations and planning of the program in manner that adds value and capitalizes on complementary opportunities between the Technology Development Program, National Pesticide Impact Assessment Program, Forest Health Technology Enterprise Team projects, and related technology development programs within the Department of Agriculture.

**BACKGROUND/RATIONALE:** Forest Health Protection (FHP) technology development projects enable the FS to continually improve integrated pest management and better protect forest health. Commencing in FY99, this program will be distinguished from the overall FHP technology development programs (TDPs) by revising the title to the Special Technology Development Program (STDP). STDP projects provide means of evaluating research results and technology efficiency in the context of field operations. The STDP projects are important to a comprehensive technology development and transfer program by ensuring very pragmatic evaluations prior to adoption and long-term support.

There is a need to more carefully coordinate the communication of STDP objectives, projects, and findings between STDP, NAPIAP, and IR4 in order to enable the field offices to take greatest advantage to the full array of funding opportunities available to them. The Enterprise Team, completing its first full year of operation in fiscal year 1996, fosters and develops technology to protect and improve the health of America's forests, and is therefore well-positioned to monitor such programs and communicate their objectives, methods, and findings in support of technology transfer.

**PRODUCTS AND DELIVERY DATES:**

1. STDP requests for proposals, proposal distribution, economic analysis of proposals, and synthesis of review team recommendations for funding allocation September 1996 through January 1997
2. Updated project report compendium and distribution to relevant parties (primarily FHP offices, other technology development units and Research) April 1997
3. Coordinate program communications with steering committees and their members, especially to improve general knowledge of and access to project findings and results Ongoing
4. Insert project records in database enabling improved review, summary, and coordination with NAPIAP projects Ongoing
5. Develop draft plan of work for coordinating STDP and NAPIAP (in collaboration with project III.7.a) March 1997

**START/END DATES:** Ongoing

**COOPERATORS:** None.

**RESOURCE REQUIREMENTS:**

Janiga	5 weeks
Funding	\$7,749 (FHTET)

PROJECT NO: II.5.a

PROJECT NAME: Support and Maintenance of Insect and Disease Models

LEADER: Adams

LEADER ROLE: Conduct and coordinate.

**PROJECT OBJECTIVE:** This task includes providing consulting service to the users. The scope of assistance ranges from answering questions through e-mail or on the phone to coordinating training sessions. Documentation is developed, distributed and maintained either electronically or in hardcopy. This information includes a variety of different manuals and visuals such as User's Guides, Keyword Guides, and Training Packages. Along with the standard set of documentation, a set of summaries and references will be created in conjunction with Region 6. These are informative overviews of the models with varying degrees of detail. The accessibility to the models through the bulletin board system and the Internet will be maintained and enhanced.

**BACKGROUND/RATIONALE:** In June members from FHTET-FC went to Portland and met with representatives from the FID staff to discuss priorities and cooperative projects for FY97. A number of the tasks listed above were emphasized at the meeting as important to Region 6. There was also a meeting of FHTET-FC members who are currently involved in analysis and modeling. These were listed as priority tasks from this group's perception also.

**PRODUCTS AND DELIVERY DATES:**

White Pine Blister Rust User's Guide	September 1997
Western Root Disease v3.0 Training Package	September 1997
One page information sheet on models	September 1997

**START/END DATES:** Ongoing

**COOPERATORS:** Rich Teck, Ralph Johnson, Gary Dixon (WO-FMSC); Intermountain Research Station, FHP and FVS Regional Coordinators.

**RESOURCE REQUIREMENTS:**

Adams	24 weeks
Funding	\$98,870 (FHTET)



PROJECT NO: II.5.b

PROJECT NAME: FVS Conference Coordination

LEADER: Adams

LEADER ROLE: Coordinate.

PROJECT OBJECTIVE: To assist the Forest Management Service Center and the Intermountain Research Station in organizing and conducting a conference on the Forest Vegetation Simulator.

BACKGROUND/RATIONALE: A Forest Vegetation Simulator (FVS) Conference will be held February 4-6, 1997 at the Forest Management Service Center in Fort Collins, CO. The conference is being organized by the Forest Management Service Center, along with Intermountain Research Station and the Forest Health Technology Enterprise Team in Fort Collins (FHTET-FC). Papers will be presented consistent with a theme of approximately eight different subject areas. There will be one or two invited papers and several contributed papers per topic along with a panel discussion. The panel discussion will be coordinated by FHTET-FC and will focus on large-scale analysis. The primary topic will be the variety of ways models can be used in forest planning. In addition, there will be concurrent break-out sessions designed for more interactive dialogue between attendees interested in discussing more specific applications. This conference will provide FHP with the setting to present the available models and relevant information to new users. There will be opportunities for interaction between model users from varied backgrounds, geographic areas, and experience levels. Ideas, knowledge, and experiences can be shared among participants.

The Regions recognized this as an important conference for anyone involved in modeling. Especially with our history of cooperation with the Forest Management Service Center, it is vital for us to play a significant role in this meeting.

PRODUCTS AND DELIVERY DATES:

Papers, posters, and a panel discussion at the conference. September 1997

START/END DATES: FY97

COOPERATORS: WO-Forest Management Service Center; Intermountain Research Station.

RESOURCE REQUIREMENTS:

Adams	6 weeks
Funding	\$11,030 (FHTET)

PROJECT NUMBER: II.5.c

PROJECT TITLE: Pest Model Interface Development

LEADER: Janiga

LEADER ROLE: Coordinate.

PROJECT OBJECTIVE: Provide a graphic interface to pest models (with improved data interchange and analytical capacity) in a manner that supports technology transfer to National Forests, States, and private parties conducting environmental assessments.

BACKGROUND/RATIONALE: Pest models integrated with the Forest Vegetation Simulation System require a user interface in order for forest and district personnel to efficiently apply the models within their local environmental assessments. The interface currently available operates only on the Data General equipment. In order to fulfill technology transfer responsibilities for the agency, states, and private parties, the Enterprise Team needs to develop new interface capabilities for both 615 and microcomputer systems. The design and user documentation for the interface must also enable users to access, exchange data with, and use other applications such as spreadsheets, GIS, and word processors.

Several groups work on projects closely related to, and interdependent with pest models. These are the FMSC, EMAC, INT, and PNW. The vegetation simulation, forest planning, and visualization tools being developed by these units are also used by pest model users. The user community justifiably expects these developers to coordinate their work efficiently; therefore, this project will be coordinated with data visualization and model support projects.

PRODUCTS AND DELIVERY DATES:

1. Pest models incorporated with SUPPOSE: September 1997
2. Application of pest models incorporated into Spectrum training and informational documentation: September 1997
3. Microcomputer-based submittal system for pest models providing, at a minimum, the capability for users to interact with models to the extent possible in the Data General submittal system and to interchange pest model outputs with MS-WINDOWS Office Suite (Access, Excel, MS-Word, etc): April 1997

START/END DATES: Ongoing

COOPERATORS: Forest Management Service Center; Ecosystem Management Analysis Center; Intermountain Station; and Forest Health Monitoring.

RESOURCE REQUIREMENTS:

Adams	2 weeks
Janiga	6 weeks
Williams	2 weeks
Funding	\$88,394 (FHTET)

PROJECT NO.: II.6.a

PROJECT NAME: Methods to Simulate Landscape Processes

LEADER: Smith

LEADER ROLE: Cooperate and conduct.

PROJECT OBJECTIVE: To continue ongoing efforts to solve bio-statistical challenges in order to adapt and expand stand-based FVS insect and disease models to landscape level analyses. Primary areas of work are: representation of stand data for stands which have not been intensively sampled; simulation of contagion events and spatial relationships across stands; integration of multiple agent impacts including fire; and expansion of model scope to recognize impacts in a disturbance ecology context. Contagion events and stand data problems will be addressed in bark beetle and defoliator models. Current prototype solutions for multiple agent integration will be tested and described. Potential contributions from disturbance and landscape ecology will be evaluated.

BACKGROUND/RATIONALE: When the Chief took his post, he said we would "Implement ecosystem management" and "...synthesize research and apply it to management of natural resources". FHTET has recognized the need and opportunity for analyses beyond the stand level for many years. Specific documented needs for work described here include: TTP (a pine beetle model), Healthy Forests for America's Future (integrate pest models into ecosystem management, p.24), implementation of TDP projects (pine beetle and western spruce budworm models), and FH2000 Strategic Plan (contagion testing of WWPB from 4.3.2.4, landscape model review and other resource integration from 4.3.1). Contact with field staffs has led us to high awareness that multi-stand, multi-agent, multi-resource projects are common and that we need to develop tools to support these analyses. Significant amounts of ecological research performed by the Forest Service and others needs to be integrated into what has been, up 'til now, primarily a tree- and stand-growth model.

#### PRODUCTS AND DELIVERY DATES:

Test of the Most Similar Neighbor and the beetle dispersion model software using the WWBP model. Delivery date: May 1997

An evaluation of current methods to combine FVS insect and disease models. Delivery date: April 1997

A review of ecological models, their potential for integration into the FVS model framework, and a prototype design for a multiple agent risk/stand vigor model. Delivery date: September 1997

START/END DATES: MSN and contagion: August 1996/May 1997  
Multi-agent approaches: January/August 1997  
Review ecosystem and landscape models: February/August 1997

COOPERATORS: University of Montana; Intermountain Fire Science Laboratory; Intermountain Research Station; Rocky Mountain Research Station; Forest Management Service Center; Region 6 (Gregg and Sheehan); and Region 1 (Hagel).

#### RESOURCE REQUIREMENTS

Smith	14 weeks
FS Detailer	10 weeks
Funding	\$55,299 (FHTET)



PROJECT NO.: II.6.b

PROJECT NAME: Biometrics Analysis and Support

LEADER: Smith

LEADER ROLE: Cooperate and conduct.

**PROJECT OBJECTIVE:** To provide biometrics analysis services to Regions to ensure the validity of surveys, field tests, and models. An important phase of the model development process is testing model validity and sensitivity. Under this task, model behavior will be systematical tested and the results used to modify the models or to inform users of appropriate model uses. High priority models for testing include the westwide pine beetle model, the western spruce budworm damage model, and the white pine blister rust model. Risk and hazard model documentation will be collected, catalogued, and the catalogue distributed as an initial effort in capturing model user experience and as a possible prelude to more formal evaluation. The potential for calibrating western models for eastern insects and diseases will be assessed. Biometrics support and project participation will be provided to FHP units as needed. Support projects begun in FY 96 that will continue into FY 97 are: the analysis of the third Vermont hardwood tree health survey, participation on the Cold Springs ID Team (Medicine Bow NF), and analysis of eastern mortality trends.

**BACKGROUND/RATIONALE:** Validation, calibration, and sensitivity analysis are recognized as important development tasks for our unit in Forest Pest Models: A Technology Transfer Plan. This need was also expressed in the FHT2000 Strategic Plan (Task 4.3.2.4), planned for FY 96-97. The need for a risk and hazard model review was cited in FHT2000 (4.5.4.1), and emphasized in recent field input to FHTET. Evaluation of eastern model potential was planned for in FH2000 (4.3.1.4). Biometrics support has proven to be a valuable core function of the unit for many years. Every year FHTET has participated in a variety of projects, either as reviewers, consultants, or full members, where statistical expertise has been a vital component in producing sound project results. A very important side benefit of this participation is better mutual understanding among FHTET, FHP, and non-FHP field staffs.

**PRODUCTS AND DELIVERY DATES:**

Sensitivity analyses report	February 1997
Annosus sensitivity presentation	April 1997
Biometrics consulting outputs	determined by cooperators
Risk and Hazard Model catalogue	April 1997
Eastern insect and disease model workshop report	April 1997

<b>START/END DATES:</b>	Validation, sensitivity support	Ongoing
	Biometrics consulting	Ongoing
	Eastern Model review	January/April 1997

**COOPERATORS:** D. Johnson, Medicine Bow NF (R2); Frankel (R5); Gregg and Sheehan (R6); NE Area; NE Forest Experiment Station; and the State of Vermont.

**RESOURCE REQUIREMENTS:**

Smith	15 weeks
Scrivner	4 weeks
Funding	\$72,266 (FHTET)

PROJECT NO.: II.6.c

PROJECT NAME: Values Determination Project

LEADER: Smith

LEADER ROLE: Conduct.

**PROJECT OBJECTIVES:** To review published surveys on stakeholder preferences for forest health management actions and outcomes by collecting the results and presenting them in a single document for forest managers. A meta-analysis of the survey results will be conducted to identify any significant trends in stakeholder preferences. Pest-related Environmental Impact Statements will be reviewed and condensed, providing good examples of values, stakeholders, issues and concerns identified, and valuation methodologies used. An alternative methodology for estimating the economic value of non-market goods, including forest health, will be developed by comparing several different methods using four recently collected data sets.

**BACKGROUND/RATIONALE:** The US Forest Service has expressed a need for more information on values and how these values are affected by forest management (RPA, WFHI, Human Dimensions Study Group). FHTET has expressed this same need along with "developing methods and technologies to identify, measure, and display forest ecosystem values and systematically relate these values to alternative forest ecosystem management actions and outcomes" (Technology 2000, Strategic Plan). A joint project receiving 50% funding from PSW Station will collect and review existing information on public preferences for forest health management actions and outcomes and how these preferences have changed over time. Alternative methods of measuring human dimension values will be developed and tested; this task is 100% funded by RM Station.

**PRODUCTS AND DELIVERY DATES:**

The methodology evaluation will be presented in professional journals and meetings, as determined by the RMS PL.

The survey review will produce a paper for publication (August 1997) and a PSW publication oriented towards managers (October 1997).

<b>START/END DATES:</b>	Methodology evaluation	October 1996/September 1997
	Survey review	October 1996/September 1997

**COOPERATORS:** Lewis (WO); Peterson (RM Station), Gonzalez-Caban (PSW Station); Loomis and Haefele (Colorado State University).

**RESOURCE REQUIREMENTS:**

Smith	4 weeks
Funding	\$27,300 (FHTET)
	\$18,000 (RM Station)
	\$10,000 (PSW Station)

PROJECT NO.: II.7.a

PROJECT NAME: INFORMS Implementation

LEADER: Williams

LEADER ROLE: Conduct and coordinate.

**PROJECT OBJECTIVES:**

- 1) Lead the effort to secure approval of INFORMS as a national application as approved by IS&T.
- 2) Develop specific and, where possible, automated procedures for installing and configuring INFORMS in an efficient and sensible way.
- 3) Foster adoption of INFORMS through installation and training assistance. R6 and R8 have staff identified for these activities, but through the first year of implementation, FHTET's expertise will be needed by other regions.
- 4) Maintain base-level efforts to fix normal first year software "bugs" and to add critical enhancements that are important to INFORMS adoption and use.

**BACKGROUND/RATIONALE:** INFORMS is the centerpiece of FHTET's work in decision support. FHTET's DSS activities are guided by the Forest Health Technology 2000 strategic plan, which outlines activities that will help integrate forest health tools and knowledge into Forest Service decision processes. INFORMS, if adopted by FS planners, does just that by providing a generic planning framework through which a variety of forest health tools and knowledge can be delivered.

Midway through FY96, alpha versions of INFORMS were installed on four sites, with more sites expected to be established by the end of FY96. Alpha version users and other sites who have seen the alpha versions are eager to begin using version 1.0 of INFORMS operationally in FY97. INFORMS could be operational in major portions of R6 and R8, and on selected sites in most other regions by the end of FY97, but this will require some guidance and involvement by FHTET.

**PRODUCTS AND DELIVERY DATES:**

- 1) INFORMS version 1.0 with accompanying installation scripts/procedures and other documentation.
- 2) National Approval designation.
- 3) INFORMS version 1.x by the end of FY97 (representing "bug" fixes and base-level enhancements).
- 4) Target of at least eight established user sites in Regions 6 and/or 8 and one site in each of two other regions.

**START/END DATES:** Ongoing

**COOPERATORS:** Forrest Oliveria (R8 FHP); Ron Perisho (Ouachita NF); Eric Twombly (R6 MS); Joe Campbell/Rob Holmes (IS&T); Susan Gray (R2 RO); Pat Jackson (R3 RO); Sue Priest (R4 RO); Doug Loh (Texas A&M University).



RESOURCE REQUIREMENTS:

Williams	14 weeks
Roschke	4 weeks
Janiga	1 week
Funding	\$77,689 (FHTET)
	\$30,000 (IS&T WO)
	\$ 5,000 (R2 RO)
	\$ 5,000 (R3 RO)
	\$ 5,000 (R4 RO)
	\$ 6,000 (R8 FH)
	\$ 5,000 (R8 Ouachita NF)
	\$ 2,000 (R6 Wallowa-Whitman NF)

PROJECT NO.: II.7.b

PROJECT NAME: Integration of Forest Health Tools within INFORMS

LEADER: Williams

LEADER ROLE: Conduct and coordinate.

**PROJECT OBJECTIVES:**

- 1) Integrate SUPPOSE within INFORMS.
- 2) Integrate insect and pathogen successional queries within INFORMS.
- 3) Facilitate and demonstrate the capability to integrate risk and hazard rating models within INFORMS. These models can be represented as either rulebases or as combination Oracle and GIS scripts.
- 4) Prioritize, coordinate, and facilitate the integration of other forest health tools such as data visualization tools and the Southern Pine Beetle Information System (SPBIS).
- 5) Assist with the completion of version 1.0 of the Rulebase Toolkit: necessary to promote end-user development of rulebases for use within INFORMS.

**BACKGROUND/RATIONALE:** There are an array of existing and emerging tools used across the Forest Service of interest to Forest Health activities. These tools include risk and hazard rating systems, simulation models, successional analysis tools, data visualization techniques, specialized databases, and other electronic repositories of forest health knowledge. Activities are ongoing to integrate these within INFORMS but there are other opportunities that are not being addressed. As INFORMS is adopted by more and more sites, integration of these tools within INFORMS can help leverage forest health issues in the planning process. This project will facilitate some of these directly and some, indirectly, through coordination with other externally funded efforts.

**PRODUCTS AND DELIVERY DATES:**

- 1) SUPPOSE accessible and functional through INFORMS. Includes a value-added utility to graphically select and group stands prior to simulation. (Note, this activity was already begun in FY96)
- 2) The 10+ risk and hazard rating models as identified in UPEST will be integrated as available tools within INFORMS. These models will be represented as rulebase and/or Oracle/GIS models. (Note, this activity began in FY96)
- 3) Plan of action for when, how, and what other forest health related tools to integrate.
- 4) Version 1.0 of the Rulebase Toolkit delivered by 2/28/97 as scheduled under the TDP.
- 5) Selected site specific models integrated within INFORMS on a site-by-site basis (funded by the end-user).

**START/END DATES:** Ongoing

**COOPERATORS:** Forrest Oliveria (R8 FH); Ron Perisho (R8 Ouachita NF); Eric Twombly (R6 MS); Nick Crookston (Int. Res. Sta.); Sue Hagle (R1 FH); Doug Loh (Texas A&M University).

RESOURCE REQUIREMENTS:

Williams 14 weeks

Funding \$43,959 (FHTET)

\$44,000 (R8 TDP to Texas A&M--funds obligated late FY96  
for use thru FY97)

\$ 2,500 (R8 FH TDP carryover)

\$12,000 (R8 Ouachita NF)



PROJECT NO.: II.7.c

PROJECT NAME: Documentation of Landscape Assessment Methods

LEADER: Williams

LEADER ROLE: Coordinate.

PROJECT OBJECTIVES: To complete and document the procedures used in Region 1 for landscape assessment methods.

BACKGROUND/RATIONALE: With completion of the R1 TDP for developing a method for assessing the role of insects and pathogens in forest succession, documentation of the methodology and its results will be needed as a record of effort and to ensure reproducibility in future projects. This documentation will also be useful for comparison with landscape assessment methodologies used in similar projects in other regions. A follow-up TDP is being drafted to pursue further refinement of this methodology at different landscape scales and to produce outputs to feed different planning models such as Spectrum. If funded, the follow-up project will kick in as this effort ends midway through FY97.

PRODUCTS AND DELIVERY DATES:

- 1) Improved/refined assessment procedures, refined data structures, data sets across additional landscapes to support more widespread use of the methodology from R1, completed CASE documentation to leverage integration of insect and pathogens issues with other resource concerns.
- 2) Established procedures and demonstrated examples of blending successional impacts of insects and pathogens into NF planning efforts.

START/END DATES: Ongoing

COOPERATORS: Sue Hagle & Jim Byler (R1 FH); Sue Frankel (R5 FH); Ellen Goheen (R6).

RESOURCE REQUIREMENTS

Williams	10 weeks
Smith	1 week
Pywell	1 week
Funding	\$56,411. (FHTET)
	\$20,000 (R1 FHP)

PROJECT NO.: II.8.a

PROJECT NAME: Internet and Intranet Services

LEADER: Roschke

LEADER ROLE: Coordinate and conduct

**PROJECT OBJECTIVES:**

Maintain and improve the FHP/FHTET web server.

Add information to, update, and maintain the FHTET Web site.

In cooperation with WO-FHP and R/A/FHM Internet Coordinators, identify, organize, and prepare forest health-related information for public display on the World Wide Web. Provide leadership and coordination to achieve consistency, quality, and organization among all FH sites linked to the Forest Service's National Perspectives and Conditions page and the associated forest health-related information. Provide assistance and consultation to field units in Web-related issues; provide space on the FHTET web server for FH information from Region and other FH units that don't currently have an alternative.

Scope and begin development of intranet services and capabilities.

**BACKGROUND/RATIONALE:** The World Wide Web provides a means to present information to and open two-way communications with a global audience. In mid FY96, FHTET built a web server and opened it to the public. The information presented focused on FHTET's capabilities, projects and products.

Late in FY96, the scope of the information presented was broadened to include the Forest Service's national perspective on forest health, including the 1996 Forest Health Update and 13 Forest Health Issue Papers. The objective is to present forest health-related information in a consistent, organized fashion and provide the potential for two-way communications with stakeholders. In order to expand the treatment of forest health-related information, WO-FHP requested each Region, the Area, and FHM to designate an Internet coordinator to provide a level of coordination, quality, and consistency at each nationally linked FH site. A coordinators kickoff meeting was held in late FY96. Continuing coordination will be required.

In FY97, Forest Service access to the Internet will expand. Implementation of the Forest Service's new IBM contract systems will expand; these will become the production systems for many sites. Use of the DG will decline significantly. This will be spurred by the broader and more robust implementation of the Forest Service-wide wide area network (WAN), which will replace the DG network upon which the Forest Service has become so reliant. The new WAN differs from the DG network in that it is based on Internet protocols, and will in effect form a Forest Service-wide "intranet" similar to internal networks used in the private sector for providing information services and conducting business that is internal in nature. The Forest Service will be able to use and develop any Internet and World Wide Web applications and services entirely within the Forest Service using this intranet. Services appropriate for public access can be developed and tuned by providing them for internal use first. There is also the potential to improve communication and collaboration between FH units through the use of groupware, which is widely used in the private sector.

**PRODUCTS AND DELIVERY DATES:**

- o A coordinated, high-quality presentation of Forest Service forest health-related information.
- o Links to all R/A conditions reports.
- o Links to other FS units with forest health responsibilities (R/A FHP, FHM).
- o Broader, improved Internet services.
- o Research, knowledge, and experience that can be directly applied to other situations.

All through September 1997

**START/END DATES:** Ongoing

**COOPERATORS:** Leah Clark (WO-FHP); Andy Wilson (WO-PAO); Grant Dekker (WO-IS&T); Larry Stipe (R1-FHP); Dick Dieckman (R2-RR); Steve Dudley (R3-FHP); Joy Roberts (R4-FHP); John Kliejunas (R5-FHP); Kathy Sheehan (R6-FHP); Wes Nettleton (R8-FHP); Anthony Elledge (R8-FHP); Beth Schultz (R10-FHP); Joe O'Brien (NA-FHP); Chuck Liff (BLM-FHM); Jessie Micales (FPL); Andy Gillespie (NEFES-FHM); Gerald McDonald (INT); Tom Rice (INT).

**RESOURCE REQUIREMENTS:**

Roschke	18 weeks
Scrivner	4 weeks
Eav	1 weeks
Clark	10 weeks
Funding	\$52,967 (FHTET)



### III. TREATMENT TECHNOLOGY

PROJECT NO.: III.1.a

PROJECT NAME: SpraySafe Manager-FSCBG Aerial Application Decision Support System

LEADER: Barry/Eav

LEADER ROLE: Coordinate, cooperate, and provide oversight.

PROJECT OBJECTIVE: To provide land managers with extended FSCBG aerial spray model capability with an easy-to-use decision support system to support safe, efficacious, and economical application of pesticides.

BACKGROUND/RATIONALE: FSCBG, a validated aerial application simulation model, provides applicators and regulators with a reliable method to calculate spray exposure, predict spray drift, and mitigate adverse effects from spraying. However, the model lacks biological dose-response prediction capability and cost/benefit analyses, and many non-technical users also find the model difficult to use and interpret. To increase the practical value of FSCBG predictions, a method for interpreting exposure data in a biologically meaningful way will be included in this project. SpraySafe Manager will be composed of seven modules: environmental, efficacy, productivity, calibration, training, database access, and aerial applicator advisor.

#### PRODUCTS AND DELIVERY DATES:

SpraySafe Handbook: A comprehensive but practical aerial application reference manual of value to operational managers.

SpraySafe Guide: A concise educational document, written for people at the field operational level.

SpraySafe Manager: A highly user-friendly, PC-based, aerial application decision support system. It will integrate predictions from a powerful aerial application simulation model with predictors for buffer zones and of biological effect so that environmental consequences of application strategies can be quantified and used to develop application strategies; with cost/benefit analyses.

Delivery date (first phase):FY97

START/END DATES: FY96/FY98

COOPERATORS: Brian Richardson (FRI), with the New Zealand forestry and pesticide industry; Harold Thistle (MTDC); Milt Teske (CDI).

#### RESOURCE REQUIREMENTS:

Barry	2 weeks
Eav	2 weeks
Funding	\$25,000 (FHTET)

PROJECT NO.: III.1.b

PROJECT NAME: Field Meteorology Handbook for Resource Managers

LEADER: Barry/Thistle

LEADER ROLE: Cooperate and facilitate.

PROJECT OBJECTIVE: To prepare and publish a book on complex terrain and forest meteorology for use in planning and conducting weather-sensitive forestry operations.

BACKGROUND/RATIONALE: There is need for a meteorology reference handbook to be used as a training and field reference document for those who conduct weather sensitive forestry operations (especially aerial spraying and prescribed burning) for the purpose of environmentally sensitive management of spray drift and smoke dispersion. Mountain and forest weather is driven by highly complex atmospheric processes that have not been adequately described and illustrated in an easy-to-understand reference manual. The field manager must have the knowledge to make important and sometimes critical decisions based upon his/her practical applications in meteorology. Smoke management, especially from prescribed burning, is a national issue.

METHODS: The work is being prepared primarily by Dave Whiteman, a well-known and respected forest meteorologist from Battelle Pacific Northwest Laboratories (NW), via an interagency agreement with Department of Energy. An editorial board made up of scientists from National Weather Service, Department of Energy, the U.S. Army, and the USDA Forest Service has been established to contribute and provide critical review. Project has been coordinated with WO staffs. Book is 75 percent complete. Allen Farnsworth and Peter Lahm (R3) will write Chapter 7 on fire weather and smoke management. Barry and Thistle will write Chapter 8 on spray operations. Graphics are being prepared by Battelle NW, and we are applying to the Government Printing Office to print and sell the book to the public.

**PRODUCTS AND DELIVERY DATES:**

Joint interagency/department publication for wide distribution  
January 1998

START/END DATES: FY96/FY98.

COOPERATORS: Harold Thistle (MTDC); Dave Whiteman (Battelle NW/Department of Energy); Bruce Grim (U.S. Army); Rusty Billingsly, Carl Gorki, and Andy Edman (National Weather Service); and Allen Farnsworth and Peter Lahm (R3). New Zealand forest industry and Forest Research Institute have expressed an interest and might join us as a cooperator.

**RESOURCE REQUIREMENTS:**

Thistle	2 weeks
Barry	2 weeks
Funding	\$1,000 (FHTET)
	\$25,000 (US Army)
	\$25,000 (National Weather Service)
	\$25,000 (Department of Energy)

PROJECT NO.: III.2.a

PROJECT NAME: Dispersion and Fate of Bacillus thuringiensis (Bt) in Forested Canyons

LEADER: Barry

LEADER ROLE: Conduct and cooperate.

PROJECT OBJECTIVES: To complete final work to evaluate the dispersion and fate of Bacillus thuringiensis (Bt) in forested mountain terrain; to evaluate the FSCBG model in predicting Bt drift; and to measure Bt drift and canopy deposition.

BACKGROUND/RATIONALE: The 1991-1993 phase of the Utah gypsy moth eradication project provided the opportunity to obtain information on the dispersion and fate of aerially applied Bt in a forested canyon. In cooperation with R4, the State of Utah, the U.S. Army, and other cooperators, FHTET-Davis staff demonstrated that Bt drifts in detectable amounts at least 5 miles from the downwind edge of treatment areas in forested, mountainous terrain; at the same time, FHTET-Davis staff also learned about Bt deposition in canopies and persistence in soil. At the conclusion of these and other analyses, we will be able to address EIS data gaps and will have expanded our ability to understand fate of Bt in this ecosystem.

METHODS: Field studies have been completed. Preliminary data have been reported and published. Additional data on fate of Bt are currently being analyzed and data will be submitted for publication.

PRODUCTS AND DELIVERY DATES:

Journal manuscript

Delivery date: January 1997

START/END DATES: FY95-FY97.

COOPERATORS: John Anhold, R4; Bob Smith, Abbott Laboratory).

RESOURCE REQUIREMENTS:

Barry	0.5 weeks
Funding	\$1,000 (FHTET)
	\$5,000 (Abbott Laboratories)



PROJECT NO.: III.2.b

PROJECT NAME: Environmental Fate of Bacillus thuringiensis Berliner var. kurstaki (Bt) in Wasatch Mountains, Utah Forest Ecosystem.

LEADER: Barry/Reardon

LEADER ROLE: Coordinate.

PROJECT OBJECTIVE: To survey, monitor, evaluate, and quantify levels and movement of Bacillus thuringiensis Berliner var. kurstaki (Bt) in soil and on foliage in Parley's and Mill Creek Canyons of the Wasatch Mountains, Utah, following aerial application to eradicate the gypsy moth.

BACKGROUND/RATIONALE: The gypsy moth (Lymantria dispar L.) was treated with Bt in Parley's and Mill Creek Canyons annually from 1989 through 1993. A void in the pre-treatment environmental analyses was the fate of Bt in this type of forest ecosystem. To address this void, a study was begun in 1992 to monitor Bt

in the soil downwind of the treatment areas. There is no current evidence of Bt proliferation or bioaccumulation; however this proposed study will be alert to this possibility and to the distinction between the Bt applied as an insecticide and naturally occurring Bt. Clearly, we do not have an understanding of the fate, distribution, types, and movement of Bt in treatment areas of this and similar ecosystems. This study will use Bt spores as a tracer to monitor fate of Bt and state-of-the-art DNA sequencing to identify Bt varieties.

METHODS: Samples of soil, surface vegetation and foliage will be collected at stations previously designated for Bt sampling during the 1992-1995 Bt in Soil Study. Other stations may be established. Soil and foliage will be collected at each station every six months. Assay at a microbiology laboratory will be immediate. A study plan will be prepared by the participants specifying detailed procedures, tasks, methods, data analyses, field collection methods, responsibilities, quality control, good laboratory practices, other laboratory procedures, reporting, and technology transfer.

PRODUCTS AND DELIVERY DATES:

Study Plan	December 1996
Mid-Year Status Report	April 1997
Year-end Report	September 1997

START/END DATES: FY97/FY98

COOPERATORS: Bruce Grim (US Army); Bob Smith (Abbott Laboratories); Dr. Jack Adams (Bioremediation Laboratory, Weber State University); Mark Quilter (Utah Department of Agriculture); and John Anhold (FHP R4).

RESOURCE REQUIREMENTS:

Barry	1 week
Reardon	1 week
Funding	\$25,000 (FHTET)
	\$5,000 (R4)
	\$5,000 (Weber State University)



PROJECT NO.: III.3.a

PROJECT NAME: Meteorological Instrumentation Support of FHP Operations

LEADER: Thistle

LEADER ROLE: Technical.

PROJECT OBJECTIVE: To provide meteorological support (consultation, weather monitoring, and data analysis) to FHP operations.

BACKGROUND/RATIONALE: Many forest protection studies and operations require weather monitoring to understand the macro- and micrometeorology that influence forest health activities. Examples include the correlation between in-canopy turbulence and pheromone efficacy; the relationship between pupae survival in gypsy moth and relative humidity; and DGPS testing in low flying aircraft.

METHODS: Deployment and operation of meteorological equipment and data reporting.

PRODUCTS AND DELIVERY DATES: Determined on a task basis.

START/END DATES: Determined by task-by-task basis.

COOPERATORS: Task-specific

RESOURCE REQUIREMENTS:

Funding \$10,000 (FHP-WO to MTDC)

PROJECT NO.: III,3.b

PROJECT NAME: Spray Drift Mitigation

LEADER: Thistle

LEADER ROLE: Technical.

PROJECT OBJECTIVE: To minimize off-target drift of pesticide by investigating the micrometeorology, terrain, and vegetation types that influence drift, and proposing solutions to forest managers. Specific areas of focus are: drift in complex terrain, the effect of vegetation and vegetative barriers on drift, and the role of atmospheric stability in drift.

BACKGROUND/RATIONALE: This project restructures two previous projects: "Drift in Complex Terrain" and "Meteorological and Vegetative Factors in Pesticide Drift". These projects have been combined under the common theme of drift mitigation.

METHODS: Modeling, field trials, and equipment evaluations will be used to improve knowledge and methods to minimize drift.

PRODUCTS AND DELIVERY DATES:

Publish journal article on VALDRIFT	FY97
Vegetative barrier field testing	FY98
Co-produce video with DuPont	FY98

START/END DATES: On-going

COOPERATORS: Lincoln Ventures (Hamilton, NZ); DuPont Corporation; Battelle Pacific Northwest Laboratory.

RESOURCE REQUIREMENTS:

Funding \$40,000 (FHP-WO to MTDC)

PROJECT NO.: III.3.c

PROJECT NAME: Pheromone Application Support

LEADER: Trent/MTDC

LEADER ROLE: Technical.

**PROJECT OBJECTIVE:** To evaluate pheromone application equipment and provide engineering support for both aerial and ground application equipment. Methods and equipment need to be investigated, evaluated, improved, and possibly developed for dispersing pheromones in tubes, capsules, flakes, pellets, and granules.

**BACKGROUND/RATIONALE:** Pheromones are chemical substances released by animals and insects to establish territories, provide a warning mechanism, or to attract other members of the same species. These pheromones can be produced synthetically and used to disrupt communications between the insects or warn insects to leave the area. Because the pheromones are usually gaseous, synthetic pheromones are encapsulated in plastic polymers that will break down slowly, allowing continuous release over time. The end product can be packaged in many forms, from plastic granules to spaghetti-like tubes or strings, and applied aerially or placed on the ground manually. Pheromone delivery systems must often handle unconventional forms of carriers, such as beads, flakes, strings, and high viscosity pastes. Over the years, application systems have been improvised without systematic engineering design. Various system deficiencies can be alleviated through engineering analysis.

**METHODS:** Maintain contact with manufacturers of pheromones and application equipment, and pheromone researchers and users.

1. Review literature and contact manufacturers to determine current state of the art.
2. Determine the equipment with the highest potential value, considering both the method of encapsulation and the application equipment itself.
3. Develop test plan for field evaluation.
4. Evaluate or cooperate in other evaluations of existing solid dispersal systems.
5. Determine if new equipment is needed; if so, prepare a level of effort report on design approaches.
6. Support the implementation of pheromone technology in the FS.

**PRODUCTS AND DELIVERY DATES:**

Modification of existing equipment;	
Summary report listing deficiencies of current equipment	
and the level of effort needed to correct these deficiencies.	FY97
Trials of existing equipment;	
Summary Report	FY98

**START/END DATES:** FY97/FY99

**COOPERATORS:** Region 8 and Region 9.

**RESOURCE REQUIREMENTS:**

Funding	\$20,000 (FHP-WO to MTDC)
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PROJECT NO.: III.3.d

PROJECT NAME: DGPS Aircraft Guidance

LEADER: Thistle

LEADER ROLE: Technical.

PROJECT OBJECTIVE: To evaluate and understand DGPS equipment used in FS and cooperator pesticide application.

BACKGROUND/RATIONALE: In aerial spraying it is critical to apply pesticide as accurately as possible in order to improve its efficiency and thereby reduce application costs and the impact on the environment. To do so, it is important to know aircraft location in real-time and to have a permanent record of flight patterns. Therefore, some type of guidance system is required to assist the pilot in the precise application of the material, and a tracking system is needed to provide a record of where the aircraft flew for later analysis of the operation or input into a GIS for future use. In the post-flight analysis phase of the operation, any gaps in application can be identified and respray accomplished.

DGPS aircraft navigation is now used extensively in FS pesticide application operations. Testing was performed in Missoula, Montana, in 1994 on these systems. Uniqueness of forest and complex terrain spraying and changing technology necessitates continued testing.

METHODS: It is proposed that testing be conducted in 1997 in western Virginia to encourage state cooperators involved with gypsy moth suppression in the eastern U.S. to attend and participate in the testing.

PRODUCTS AND DELIVERY DATES:

Comprehensive report on Appalachian testing	FY97
Test Description and Results	January 1998

START/END DATES: FY93/FY98

COOPERATORS: Region 8, Region 9, state cooperators, and the DGPS systems industry.

RESOURCE REQUIREMENTS:

Funding	\$35,000 (FHP-WO to MTDC)
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PROJECT NO.: III.3.e

PROJECT NAME: Seed Orchard Sanitation

LEADER: Windell/MTDC

LEADER ROLE: Technical.

PROJECT OBJECTIVE: The objective of this project is to investigate equipment for use in the removal of cones and other organic matter that provide pest habitat in seed orchards.

BACKGROUND/RATIONALE: This project is in its second year and evolved from a project that focused on burning to achieve the objective. Project status is reported in Windell (1995). A test of ground burning equipment is scheduled for October, 1996. Steaming, sweeping, and pulverization equipment have also been considered and are being investigated under this project.

METHODS: The approach to date has been to perform market and literature searches to identify similar equipment being used in other agricultural arenas. This has proven successful in identifying promising equipment. One test of a ground burner to evaluate surface heating has been performed, and another, more detailed, test is planned. Other methods mentioned above are also being evaluated.

**PRODUCTS AND DELIVERY DATES:**

Summary Report on Ground Burner	September 1997
Final Project Report	September 1998
(The final report on this project may be later if any of the alternative technologies warrant evaluation.)	

START/END DATES: FY95/FY98

COOPERATORS: Region 6 and Region 8.

**RESOURCE REQUIREMENTS:**

Funding	\$30,000 (FHP-WO to MTDC)
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PROJECT NO.: III.3.f

PROJECT NAME: Engineering Services

LEADER: Thistle

LEADER ROLE: Technical.

PROJECT OBJECTIVE: To provide prompt engineering services on request, and to coordinate program planning support to the sponsoring Washington Office unit.

BACKGROUND/RATIONALE: At the request of the Forest Health Protection (FHP) staff, the Center: conducts special investigations and studies; participates in field programs; evaluates employee suggestions; contacts field personnel to determine instrumentation and equipment needs; delivers presentations on FHP methods at training sessions, meetings, and workshops; provides follow-up services on completed development projects and answers requests for technical information from field units, Government Agencies, and industry; publishes reports; prepares manuscripts for journal publications; and handles program planning and Washington Office coordinator activities for Forest Insect and Disease Management projects at the Center.

MTDC represents a unique resource of people, knowledge, and professional and technical skills, and provides the only source of mechanical and electrical engineers in the Forest Service other than those in Research. Historically, FHP has called upon MTDC for immediate and short-term professional judgements, on-site support, contract specifications, equipment evaluations, and assistance in Technology Transfer activities. Need for these services will, at a minimum, continue at current levels and likely will increase.

**METHODS:**

1. Attend National meetings and workshops, present papers and prepare manuscripts for journal publication.
2. Act promptly on routine requests and inquiries, including publishing, illustrating, and photography.
3. Coordinate MTDC project capabilities with requests from Regions, NA, WO, and FPM units.
4. Complete reports for terminated projects and status reports.
5. Initiate new projects as directed by FPM WO (assignments subject to revision).

PRODUCTS AND DELIVERY DATES: The tasks and continuing and subject to customer needs. Historically MTDC has provide approximately \$25,000 of engineering support annually to FHP units, many of which are projects of opportunity and projects that are unplanned due to rapid changes in forest management approaches and techniques.

START/END DATES: Ongoing

COOPERATORS: N/A

**RESOURCE REQUIREMENTS:**

Funding                      \$25,000 (FHP-WO to MTDC)

PROJECT NO.: III.3.g

PROJECT NAME: Model Testing and Evaluation

LEADER: Thistle

LEADER ROLE: Technical.

PROJECT OBJECTIVE: To support application of pesticide-use decision-support systems and models.

BACKGROUND/RATIONALE: Decision support systems (DSSes) have been developed that use descriptions of meteorological processes, application methods, and equipment to simulate dispersion and deposition of airborne materials. Analysis of data is on-going, and models have been improved and verified through field trials. Training in the use of the models began in FY 1988 and will continue as the models evolve and become more sophisticated. MTDC has played an integral role in the development of the FS spray dispersion models. The modeling system currently in use (FSCBG) consists of two basic model types with a third planned. The far-field model is Gaussian, and has been adopted from U.S. Army models; the near-field model is a Lagrangian transport model developed under contract to the FS; the third and newest part is a phenomenological model describing transport in complex terrain. Both the near field and the complex terrain models have been developed under contracts overseen through MTDC.

METHODS: Complete interface of complex terrain spray drift model (ValDrift).

PRODUCTS AND DELIVERY DATES:

A prototype FSCBG system incorporating ValDrift	FY98
A finalized FSCBG system incorporating ValDrift	FY98
An improved canopy interception algorithm	FY98

START/END DATES: Ongoing

COOPERATORS: U.S. Department of Defense, USAF, Spray Drift Task Force; agencies in Canada and New Zealand; U.S. Department of Energy.

RESOURCE REQUIREMENTS:

Funding	\$50,000 (FHP-WO to MTDC)
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PROJECT NO.: III.3.h

PROJECT NAME: Graphical Enhancements and Operational Systems Updates

LEADER: Thistle

LEADER ROLE: Technical.

PROJECT OBJECTIVE: To incorporate new technology into the DSS so that the FS systems remain state-of-the-art and user-friendly.

BACKGROUND/RATIONALE: The FS has been developing models and DSSes for over twenty years. This experience has shown that implementation and a continued user base requires that up-to-date techniques be used. This imparts a 'modern' feel to these systems that the users recognize and are comfortable with. In the history of FS modeling activities, modeling has moved from mainframes to PCs, and it is expected that the vehicle of this technology to the user will continue to change with time.

METHODS: The primary goal will be to work with various FS groups to move the DSSes to modern platforms such as Windows 95 and NT. New graphics options and enhancements will also be tracked and implemented when appropriate. This project will also support incorporation of the FSCBG modeling system into decision support systems such as GYPSES and into expert systems such as those being developed by USAF.

PRODUCTS AND DELIVERY DATES:

Windows version of FSCBG	FY98
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START/END DATES: Ongoing

COOPERATORS: Region 9; state cooperators.

RESOURCE REQUIREMENTS:

Funding	\$15,000 (FHP-WO to MTDC)
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PROJECT NO.: III.3.i

PROJECT NAME: FSCBG System and User Group Management

LEADER: Thistle

LEADER ROLE: Technical.

PROJECT OBJECTIVE: To support training and the technical transfer of models that support the safe and effective application of pesticides.

BACKGROUND/RATIONALE: The FS has supported the upkeep, training, and maintenance of the FS models, which are widely used. This is a critical component in transferring this technology into the field for use by the application community.

**METHODS:**

1. Continue technology transfer of the FSCBG modeling system.
2. Assist FSCBG User Group in conducting training sessions and in keeping user materials and information current.
3. Continue to provide support for systems management and implementation of existing models plus support the introduction and application of new models.

**PRODUCTS AND DELIVERY DATES:**

Ongoing support, training and maintenance of FS pesticide spray dispersion models. Delivery date: September 1997.

START/END DATES: Ongoing

COOPERATORS: Model users are FS, state, industry, and international entities.

**RESOURCE REQUIREMENTS:**

Funding \$30,000 (FHP-WO to MTDC)

PROJECT NO: III.4.a

PROJECT NAME: QA/QC Standards for Formulations of Semiochemicals

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVE: To develop and implement quality assurance/quality control (QA/QC) standards for formulations of semiochemicals that are used for monitoring and managing Lepidoptera.

BACKGROUND/RATIONALE: At the present time, there are no established standard QA/QC guidelines for commercially manufactured semiochemical formulations that are used for monitoring and managing lepidopteran species. These products are documented for initial loading of pheromone, but formulation, composition and release rate data are not readily available to product users.

METHODS: 1) Consult with scientists and commercial manufacturers of semiochemical products to summarize current "in-house" QA/QC protocols; 2) develop draft standard QA/QC guidelines with review from 1); 3) prepare final QA/QC guidelines; and 4) analyze selected currently registered semiochemical products for lepidopteran species using the newly developed QA/QC guidelines.

PRODUCTS/DELIVERY DATES: A uniform set of QA/QC guidelines for formulations of semiochemicals for lepidopteran species. Delivery date: December 1997.

START/END DATES: FY96/FY97

COOPERATORS: The USDA Agricultural Research Service will assist in developing the draft of QA/QC guidelines and conduct the initial evaluation of a subset of formulations; Donna Leonard (USDA Forest Service R8-FH); Vic Mastro (USDA APHIS); Brad Onken (USDA Forest Service NA-FH).

RESOURCE REQUIREMENTS:

Reardon	2 weeks
Funding	\$5,000 (FHTET)

PROJECT NO: III.4.b

PROJECT NAME: 4-AA to Protect Individual Trees from Southern Pine Beetle

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVE: To refine application technology for 4-AA in an effort to develop an operational technique to protect high-value trees from infestation by southern pine beetle (SPB).

BACKGROUND/RATIONALE: 4-AA is a novel host compound that has been developed specifically to repel SPB and associated bark beetles from individual trees. 4-AA has proven efficacious but additional formulations/dispensers and associated release rates need to be evaluated.

METHODS: Experimental plots will be selected within areas of SPB activity. Efficacy and release rates will be assessed for at least three different types of formulations/dispensers of 4-AA.

PRODUCTS/DELIVERY DATES: A cost-effective and environmentally compatible technique for application of 4-AA to protect high-value, small stands or single trees from SPB and associated bark beetle attacks. Delivery date: September 1998.

START/END DATES: FY94/FY98

COOPERATORS: Jane Hayes (Southern Research Station); Bobbe Fitzgibbon (USDA Forest Service, R8-FH); Stephen Clark (USDA Forest Service, R8-FH).

RESOURCE REQUIREMENTS:

Reardon	1 week
Funding	\$10,000 (FHTET)



PROJECT NO.: III.4.c

PROJECT NAME: Develop Semiochemicals for Operational Use

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVES: 1) To develop aerial application technology for operational use of Hercon flake and biosys Inc. bead formulations of disparlure on large acreages, and 2) to evaluate disparlure plume dispersal within a forest area.

BACKGROUND/RATIONALE: The current commercially produced time-release formulations of racemic disparlure are aurally applied using specialized equipment, thereby limiting the operational use of the mating disruption technique. This application technology needs to be modified or new technology developed to promote wider use of these products.

METHODS: Conduct a series of airport and small plot evaluations in cooperation with MTDC using the newly developed/modified technology for application of flakes and beads. Cooperate with MTDC in evaluating plume dispersal as part of an ongoing effort in Oregon and a new effort in Virginia.

PRODUCTS/DELIVERY DATES: Application equipment for time-release formulations containing racemic disparlure. Delivery date: December 1997.

START/END DATES: FY96/FY98

COOPERATORS: Andy Trent/Harold Thistle (MTDC); Vic Mastro (USDA-APHIS); Barbara Leonhardt (USDA-ARS); Donna Leonard (USDA Forest Service, R8-FH); Priscilla MacLean (Hercon, Inc.); Tom Walgenbock (biosys, Inc.); Ivan Rash (Loveland Industries); Brad Onken (USDA Forest Service, NA-FHP).

RESOURCE REQUIREMENTS:

Reardon	2 weeks
Funding	\$30,000 (FHTET)

PROJECT NO.: III.4.d

PROJECT NAME: Analysis and Environmental Fate of Insect Growth Regulators

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVES: 1) To develop a method for extraction and HPLC/electrospray/mass spectrometric analysis of tebufenozide (RH-5992, the active component of MIMIC) from environmental samples; and 2) to study the persistence of MIMIC on tree foliage, in underlying ground litter, and in soil in an Ohio forest and a West Virginia forest throughout a growing season and post leaf-fall.

BACKGROUND/RATIONALE: Forest health includes the health of the entire ecosystem. The main goal of insecticide use against forest defoliators is to have the highest impact on the target organism while minimizing impacts on non-target species. These studies will address the environmental fate of an insecticide considered for registration and use operationally against defoliators. Knowing where and at what levels this insecticide goes after application can help assess impacts to non-target species and efficacy against the target species.

METHODS: The field study and sample storage methods for the MIMIC persistence project will be the same as those for the study of diflubenzuron persistence in the Fernow Experimental Forest: leaves, ground litter, and soil will be sampled over time. Laboratory methods are in the development stages to determine the best extraction and concentration procedures prior to HPLC/electrospray/mass spectrometric analysis.

PRODUCTS/DELIVERY DATES: Data on persistence of tebufenozide in broadleaved forests to support the registration of tebufenozide. Delivery date: December 1997.

START/END DATES: FY95/FY97

COOPERATORS: John Long (Rohm and Haas Co.); Mary Wimmer (Department of Biochemistry, West Virginia University); Brad Onken (USDA Forest Service, NA-FHP).

RESOURCE REQUIREMENTS:

Reardon	0.5 weeks
Funding	\$10,000 (FHTET)

PROJECT NO: III.4.e

PROJECT NAME: Optimize Nucleopolyhedrosis Products for Operational Use

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVE: To improve application technology, formulations and strains of nucleopolyhedrosis viruses (NPVs; e.g., Gypchek, TM-BioControl-1, and Neocheck-S) registered by the USDA Forest Service.

BACKGROUND/RATIONALE: Application technology currently used for biopesticides was originally developed for chemical insecticides, and there is an urgent need to improve this technology. Also, formulations and strains of NPVs need to be improved in an effort to maximize deposition and efficacy.

METHODS: Develop formulations and strains for evaluation in laboratory, spray tower, and field tests. Also, quantify deposition of the gypsy moth nucleopolyhedrosis virus across a hardwood forest edge.

PRODUCTS/DELIVERY DATES: An operationally effective dose, rate, formulation, and application equipment for each NPV. Delivery date: December 1998.

START/END DATES: FY95/FY98

COOPERATORS: John Podgwaite (USDA Forest Service); John Cunningham (Forestry Canada); Kevin Thorpe (USDA ARS); Jeff Witcosky (USDA Forest Service, R8-FH); Bernie Raimo (USDA Forest Service, NA-FHP).

RESOURCE REQUIREMENTS:

Reardon	4 weeks
Funding	\$30,000 (FHTET)

PROJECT NO.: III.4.f

PROJECT NAME: Silvicultural Prescriptions for Gypsy Moth - Demonstration

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: To determine the relative efficacy of selected silvicultural and insecticide options for minimizing gypsy moth impacts to forest stands.

BACKGROUND/RATIONALE: Silvicultural prescriptions have been developed for protection of forest stands threatened by the gypsy moth. In 1991, the Appalachian Integrated Pest Management-Gypsy Moth Program (AIPM Program) initiated efforts to locate and implement these prescriptions on plots within the George Washington and Jefferson National Forests. Tree vigor in these plots is monitored annually. Gypsy moth populations have been monitored in these stands although populations have not increased as projected, primarily due to the gypsy moth fungus, and FHTET involvement in the project will terminate in 1997.

METHODS: Approximately 35 stands received the silvicultural prescriptions, with additional stands located as untreated controls or for insecticide treatments.

PRODUCTS/DELIVERY DATES: Recommendations concerning silvicultural prescriptions for managing gypsy moth. Delivery date: December 1997.

START/END DATES: FY94/FY97

COOPERATORS: Russ MacFarlane (Jefferson National Forest); Kurt Gottschalk (FIDR); Jeff Witcosky (USDA Forest Service, R8-FH); Brad Onken (USDA Forest Service, NA-FHP).

RESOURCE REQUIREMENTS:

Reardon	0.5 week
Funding	\$5,000 (FHTET)



PROJECT NO.: III.4.g

PROJECT NAME: Development of Entomophaga maimaiga for Operational Use

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVES: 1) To determine an effective and environmentally benign mechanism for dispensing the fungus (the only method now available involves movement of spores in soil); 2) to develop an effective formulation for ground/aerial application of the fungus; 3) to obtain the necessary experimental use permits for the fungus from US-EPA; and 4) to use the fungus as a component of suppression, slow-the-spread, and eradication programs.

BACKGROUND/RATIONALE: The fungus, Entomophaga maimaiga was introduced into the United States in the early 1900s. It was not recovered at the original release sites but, during 1989, was recorded in gypsy moth populations in areas surrounding and including the State of Connecticut. Since that time, this fungus has spread rapidly although sporadically throughout the East. The fungus is associated with low- to high-density gypsy moth populations.

The fungus is specific to gypsy moth and effective as a mortality agent at various host levels. The only other gypsy moth-specific registered microbial for use as a biopesticide against gypsy moth is the nucleopolyhedrosis virus product Gypchek, which is only effective against moderate-to-dense gypsy moth populations.

PRODUCTS/DELIVERY DATES: An efficacious pathogen for use as a biopesticide in suppression, slow-the-spread, and eradication programs.

START/END DATES: FY97/FY99

COOPERATOR: Ann Hajek (Cornell University); Ralph Webb (USDA ARS); Jeff Witcosky (USDA Forest Service, R8-FH); Dennis Souto (USDA Forest Service, NA-FHP).

RESOURCE REQUIREMENTS:

Reardon	2 weeks
Funding	\$30,000 (FHTET)

PROJECT NO: III.5.a

PROJECT NAME: Establish an Effective Natural Enemy Complex in North America for Hemlock Woolly Adelgid

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVE: 1) To survey for potential exotic and native predators and pathogens of hemlock woolly adelgid (HWA); 2) to develop methods for rearing predators of hemlock woolly adelgid (HWA) for eventual release; 3) to design standard protocols to sample HWA and predator populations; 4) to release, to determine the effectiveness of, and to establish natural enemies of HWA; and 5) to develop an effective biological control program for HWA.

BACKGROUND/RATIONALE: The HWA is becoming a serious pest of hemlock in the eastern United States. The present control option is the ground application of chemical insecticides, but this tactic is not appropriate for scattered and inaccessible hemlock, nor for hemlocks in riparian areas. Biological control offers an option for control of HWA in these areas.

METHODS: Collect predators of HWA from Asia, ship predators to quarantine facilities in the United States, release predators for establishment, and evaluate the predators for distribution and effectiveness.

PRODUCTS/DELIVERY DATES: Expand the natural enemy complex for HWA and monitor their effect on damage caused by this pest species. Delivery date: December 1998.

START/END DATES: FY95/FY98

COOPERATORS: Mark McClure (Connecticut Agricultural Experiment Station); Dennis Souto and Brad Onken (USDA Forest Service, NA-FHP); Kathy Shields and Michael Montgomery (USDA Forest Service - NE Forest Experiment Station); Rusty Rhea (USDA Forest Service R8-FH); Chuck Parker (USDI U.S. Geological Survey, Biological Research Division); Scott Salom (Virginia Polytechnic Institute and State University); Bruce Parker (University of Vermont).

RESOURCE REQUIREMENTS:

Reardon	2 weeks
Funding	\$75,000 (FHTET)

PROJECT NO: III.5.b

PROJECT NAME: Develop Biocontrols for Mile-A-Minute Weed

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVE: To coordinate the establishment of an effective natural enemy complex for Mile-a-Minute Weed.

BACKGROUND/RATIONALE: Mile-a-Minute Weed is a noxious weed that is rapidly spreading throughout the eastern United States as well as in Florida. Currently, only chemical controls are used to manage this weed, and their use is limited to selected habitats and short-term effectiveness. The current distribution of this noxious weed is unknown, and an identifier specific to mile-a-minute weed needs to be determined as part of aerial surveys.

METHODS: 1) Review the literature to obtain baseline data on natural enemies of Mile-a-Minute weed; 2) collect exotic and native natural enemies, rear for establishment or to augment populations of these natural enemies, and evaluate their establishment and effectiveness; and 3) to develop a survey technique for determining the distribution and spread of this noxious weed.

PRODUCTS/DELIVERY DATES: Effective natural enemy complex for Mile-a-Minute Weed. Delivery date: December 1999.

START/END DATES: FY97/FY99

COOPERATORS: Gary DeBarr (USDA Forest Service); Bill Day/Gary Buckingham (USDA-ARS); Gary Johnston (USDI-NPS); Tom Hall (Pa. Bureau of Forestry); Scott Kurtzman (Gladfelter Paper Co.); Ernest Delfosse (USDA-APHIS); Tom Finn (Virginia Dept. of Agriculture and Consumer Services); Phil Tipping (Maryland Dept. of Agriculture); Jim Frederick (University of Delaware, Dept. of Entomology and Applied Ecology); Yun Wu (Michigan Technological University); Jim Meeker (Florida Division of Forestry); James Brown (USDA Forest Service, R8-FH).

RESOURCE REQUIREMENTS:

Reardon	4 weeks
Funding	\$50,000 (FHTET)

PROJECT NO.: III.5.c

PROJECT NAME: Impact of Exotic Natural Enemies Released in North America on  
Non-target Lepidopteran Hosts

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVES: 1) To determine if the gypsy moth tachinid parasite Compsilura concinnata is an important source of mortality on two species of native forest Lepidoptera: the solitary feeder spicebush swallowtail (Papilio troilus) and the gregarious feeder Prometheus moth (Callosamia promethea); 2) to determine if naturally occurring population densities of gypsy moth influence attack rates by C. concinnata on P. troilus and C. promethea; and 3) to determine the impact of C. concinnata and other gypsy moth parasites on naturally occurring populations of brown-tail moth, Euproctis chrysorrhoea (L.).

BACKGROUND/RATIONALE: The introduction and release of exotic species of parasites to control the gypsy moth in North America has been ongoing for approximately 60 years. Many of the exotic parasites are polyphagous, with the most notable being Compsilura concinnata, with over 240 recorded hosts.

PRODUCTS/DELIVERY DATES: Data concerning the impact of exotic polyphagous parasites on host and non-host species. Delivery Date: December 1999.

START/END DATES: FY97/FY99

COOPERATORS: Joe Elkinton and Roy VanDriesche (University of Massachusetts); Dennis Souto (USDA Forest Service, NA-FHP).

RESOURCE REQUIREMENTS:

Reardon	1 week
Funding	\$20,000 (FHTET)



PROJECT NO: III.5.d

PROJECT NAME: Biological Control Program for Woodwasp in South America

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVES: 1) Assist in the development of a biological control program for the woodwasp Sirex noctilio, including the establishment of a parasite complex for minimizing damage caused by this pest species; and 2) provide training to forest managers representing several South American and African countries in biological control and monitoring techniques for S. noctilio.

BACKGROUND/RATIONALE: The woodwasp Sirex noctilio is spreading rapidly in South America and was recently introduced into Africa. An effective biological control program has already been developed for this pest in Australia and New Zealand.

METHODS: 1) Collect parasites of Sirex noctilio from New Zealand and Australia; 2) ship parasites to quarantine facility in Brazil for rearing and release; 3) host a workshop in Brazil for training forest managers in biological control and monitoring techniques; and 4) evaluate the distribution and effectiveness of the parasites.

PRODUCTS/DELIVERY DATES: 1) Forest scientists trained in biological control and pest monitoring; and 2) importation and release of parasites to suppress populations of Sirex noctilio. Delivery date: December 1997.

START/END DATES: FY95/FY97

COOPERATORS: Sean Murphy (International Institute of Biological Control); Edson Tadeu Iede (CNP Florestas/EMBRAPA Brazil); Andy Knapp (USDA Forest Service, R4-FHP); Dennis Haugen (USDA Forest Service, NA-FHP).

RESOURCE REQUIREMENTS:

Reardon	1 week
Funding	\$4,000 (FHTET)

PROJECT NO: III.5.e

PROJECT NAME: IPM Program for Common Pine Shoot Beetle

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: To assist in the development of an operational integrated pest management (IPM) program for the Common Pine Shoot Beetle.

BACKGROUND/RATIONALE: The common pine shoot beetle (Tomicus piniperda) has become established in the US and Canada in the general area bordering several of the Great Lakes, and poses a severe threat to numerous conifer species. This pest has not been recovered in the South or West, but preliminary evaluations suggest the beetle can attack several southern coniferous species. A quarantine has been established by APHIS for shipping specific articles from the Lake States, but treatments are limited for these regulated articles. In the short term, a compliance agreement needs to be developed as an option to the quarantine for movement of Christmas tree and nursery stock; in the long-term, a IPM program is needed to manage this pest. Biological control offers an essential component of an IPM program.

METHODS: Meet with representatives from research and action agencies currently involved in managing this pest. The preparation of a summary of what is known about this pest species, including opportunistic natural enemies recovered and desired characteristics of exotic control species. Prepare a plan for the development of an overall IPM program, including the development of pest management zones for the common pine shoot beetle.

PRODUCTS/DELIVERY DATES: Operational compliance agreement program for movement of Christmas trees and nursery stock, and preliminary evaluation of the impact of biological controls for the common pine shoot beetle. Delivery date: December 1997.

START/END DATE: FY95/FY97

COOPERATORS: Vic Mastro/Bill Kauffman (USDA-APHIS); Robert Haack (USDA NC Forest Experiment Station); Clifford Sadof (Purdue Univ.); Debbie McCullough Michigan State University); Janet Knodel (Cornell Univ.); David Nielson (Ohio State Univ.); Mike Connors (USDA Forest Service, NA-FHP).

RESOURCE REQUIREMENTS:

Reardon	1 week
Funding	\$8,000 (FHTET)

PROJECT NO.: III.5.f

PROJECT NAME: Biological Control of Weeds in the Western U.S.

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: To compile and distribute information on the past and current use of biological controls to manage noxious weeds in forest ecosystems in the West.

BACKGROUND/RATIONALE: There has been a great deal of research among numerous scientists world-wide concerning the use of natural enemies to control noxious weeds. In the western U.S., these efforts have not been adequately documented, reviewed, summarized, or distributed. This effort is intended to address those data gaps.

METHODS: 1) Interview subject-matter specialists and pest managers concerning efforts to manage noxious weeds; and 2) publish and distribute a report on the current status-of-effort in using natural enemies for managing noxious weeds in the western U.S.

PRODUCTS/DELIVERY DATES: Electronic database and report summarizing the status of biological control efforts for noxious weeds in forest ecosystems in the western U.S., with updates scheduled for every five years. The database will be made available on the Forest Service communication network and the Internet. Delivery date: December 1997.

START/END DATES: FY95/FY97

COOPERATORS: George Markin (USDA - Intermountain Forest and Range Experiment Station); Neal Spencer (USDA-ARS); Dave Thomas (USDA Forest Service, WO-FHP); James Olivarez (USDA Forest Service, R1-FRM); Jed Dewey (USDA Forest Service, R1).

RESOURCE REQUIREMENTS:

Reardon	1 week
Funding	\$10,000 (FHTET)

PROJECT NO: III.5.g

PROJECT NAME: Cooperative Biological Control Projects

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVE: To expedite among USDA agencies (Agricultural Research Service, Forest Service, and Animal and Plant Health Inspection Service) and in the development and use of natural enemies to manage forest and urban pest populations.

BACKGROUND/RATIONALE: Recent increased emphasis on utilization of natural enemies to manage forest pests along with reduced budgets has increased the need for cooperative efforts among agencies. The USDA Agricultural Research Service, Animal and Plant Health Inspection Service, and the Forest Service are all mandated to expand the development and application of biological controls, and are therefore logical cooperators.

METHODS: In the past, the annual Gypsy Moth Research Forum has provided the opportunity for representatives from the various agencies to meet and discuss potential projects. In FY96, collections of the braconid parasite Rogas indiscretus were initiated in India and shipments received in the ARS quarantine facility in Newark, DE. This braconid parasite will be released at several sites infested with gypsy moth in spring 1997. In FY97, emphasis will probably be placed on providing technical assistance for rearing in the laboratory and for evaluating field releases of Rogas.

PRODUCTS/DELIVERY DATES: Expedite the implementation of natural enemies for managing pest species.

START/END DATES: Ongoing

COOPERATORS: Roger Fuester/Paul Schaefer (USDA-ARS); Bill Kauffman, (USDA-AHIS).

RESOURCE REQUIREMENTS:

Reardon	0.5 week
Funding	\$5,000 (FHTET)



PROJECT NO: III.5.h

PROJECT NAME: Mycorrhizae to Suppress Root Diseases on Conifers in Nurseries

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: To determine the species (strain) of ectomycorrhizae (ECM) fungus and the combinations with other treatments for suppression of root diseases and promoting seedling growth.

BACKGROUND/RATIONALE: Root diseases have caused severe losses of both conifer and hardwood seedlings in forest tree nurseries, and is a significant problem in seedbeds and in transplant stock. For example, Cylindrocladium root disease is reported in 20 eastern and central states, in the state of Washington, and in the provinces of Quebec and Ontario, Canada.

METHODS: Pre-treatment and post-treatment soil and disease sample collections will be made in a Pennsylvania nursery which has natural infections of Cylindrocladium spp. Disease incidence and pathogen populations will be estimated quantitatively. Ectomycorrhizal fungi screening and compatibility testing for the selected ectomycorrhizal fungus with the other control agents will be conducted in the laboratory and greenhouse. Techniques of ectomycorrhizal inoculation and root disease control tests will be conducted in a greenhouse or growth chamber with all combinations of treatments. Field tests will be conducted in the nursery. The selected ECM fungus will be used to control Cylindrocladium root disease with or without the combination of other control agents, including other microorganisms, a cover crop, and a soil additive.

PRODUCTS/DELIVERY DATES: Biological control option for managing Cylindrocladium root disease. Delivery date - March 1998.

START/END DATE: FY95/FY98

COOPERATORS: Yun Wu/Margaret Gale (Michigan Technological University); Martin MacKenzie/Al Iskra (USDA Forest Service, FHP); Cindy Ocamb (USDA Forest Service).

RESOURCE REQUIREMENTS:

Reardon	0.5 week
Funding	\$10,000 (FHTET)

PROJECT NO: III.5.i

PROJECT NAME: Establish Parasites of the Mealybug Oracella acuta in the People's Republic of China

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVES: 1) To establish and/or identify dense populations of Oracella acuta in pine plantations in Georgia for collecting natural enemies; 2) to identify the major parasites that may be used in a classical biological control program in the Peoples Republic of China (PRC); and 3) to arrange to collect and ship natural enemies to the PRC for establishment in quarantine and subsequent release into the field.

BACKGROUND/RATIONALE: The mealybug Oracella acuta was introduced into PRC from the US. This mealybug is infesting nearly half a million hectares and causing severe tree growth loss. Establishing controls for mealybug has a high priority for the PRC Ministry of Forestry.

METHODS: In 1994, a plantation of loblolly pine in Mississippi was selected for collecting mealybug parasites. The plantation was mowed and monthly insecticide applications made to a 3-5 acre area in the plantation. Mealybug populations developed and parasitized mealybugs were collected.

In 1995 and 1996, efforts were continued to collect and identify ten (10) parasites of this mealybug, increase parasite colony production in quarantine, and ship parasite colonies to PRC for rearing and release.

In 1997 and 1998, shipments of parasites to the PRC will continue, with emphasis being placed on the release of shipped specimens and maintenance of laboratory colonies.

PRODUCTS/DELIVERY DATES: Natural enemies of the mealybug established in PRC. In 1997 and 1998, shipments of parasites to the PRC will continue, with emphasis being place on the release of shipped specimens and monitoring of laboratory colonies. Delivery date: December 1998.

START/END DATE: FY95/FY99

COOPERATORS: Wayne Berisford (University of Georgia); Gary DeBarr (USDA Forest Service-Southeast Forest Experiment Station); Stephen Clarke (USDA Forest Service-FH); Chen Mu Rong (Guangdong Provincial Pest Control Station); Wu Jian (Chinese Academy of Forestry, Research Institute of Forest Protection); Sun Jianghua (Northeastern Forestry Univ., Harbin, PRC).

RESOURCE REQUIREMENTS:

Reardon	0.5 week
Funding	provided by external sources (e.g., PRC)

PROJECT NO: III.5.j

PROJECT NAME: Establish Natural Enemies of Cypress Aphid in Kenya

LEADER: Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: 1) To locate, collect, and rear parasites and invertebrate predators of the cypress aphid from populations in North America, Mexico, India, and Pakistan; and 2) to ship these parasites and invertebrate predators to a quarantine facility in England for eventual release in Kenya.

BACKGROUND/RATIONALE: The cypress aphid is a major pest of cypress, not only in Kenya, but also in surrounding countries. Biological control is the preferred management strategy.

METHODS: Parasites of the cypress aphid were collected and shipped to a quarantine facility for rearing and taxonomic identification. Additional field collections will be conducted in 1997.

PRODUCTS/DELIVERY DATES: Establish a natural enemy complex for cypress aphid in Kenya in order to minimize damage caused by this pest species. Delivery date: December 1997.

START/END DATE: FY94/FY97

COOPERATORS: Daniel Kucera (USDA Forest Service, NA-FHP); Joseph Mwangi (Kenya FHMC); Sean Murphy (International Institute of Biological Control); Robert Averill/Susan Johnson (USDA Forest Service, R2-FHM); Denny Ward (USDA Forest Service R8-FH).

RESOURCE REQUIREMENTS:

Reardon	0.5 week
Funding	\$5,000 (provided by external sources)

PROJECT NO.: III.5.k

PROJECT NAME: Develop an Integrated Management System for Cogongrass in Southern Pine Forest Ecosystems

LEADER: Reardon

LEADER ROLE: Cooperate and coordinate.

PROJECT OBJECTIVES:

1. To integrate presently available control strategies for the suppression of cogongrass, including fire, mowing, disking, and herbicide.
2. To develop criteria for selection and evaluation of appropriate biological control agents.
3. To integrate conventional control methods with the most successful biological control approaches.
4. To recommend long-term forest management strategies that are compatible with maintaining desirable plant communities.

BACKGROUND/RATIONALE: Cogongrass, Imperata cylindrica (L.) Beauv, was imported into Florida in the 1940s in hopes that it would be a good forage grass and help control soil erosion. Cogongrass proved to be unsuitable for forage and its ability to spread and displace desirable vegetation outweighed any soil erosion control consideration. There are several species of native arthropods and pathogens with demonstrated potential to control this noxious weed.

The Florida Exotic Pest Plant Council and Florida Division of Forestry have deemed cogongrass a Category One invasive species, and the USDA-Animal and Plant Inspection Service and Florida Department of Agriculture and Consumer Services have listed it as a high-priority noxious weed, as well as one of the top priorities in maintaining overall Forest Health.

PRODUCTS/DELIVERY DATES: An effective integrated management system for cogongrass in southern pine forest ecosystems. Delivery date: December 2001

START/END DATES: FY97/FY01

COOPERATORS: Ed Barnard (Florida Department of Agriculture); Karl Siderits (USDA Forest Service National Forests in Florida); Gary DeBarr (USDA Forest Service Southern Research Station); James Brown (USDA Forest Service Herbicide Specialist, R8-FHP); Dan Shilling (University of Florida); Ernest Delfosse (USDA APHIS - Biological Control Institute).

RESOURCE REQUIREMENTS:

Reardon	5 weeks
Funding	\$50,000 (FHTET)
	\$10,000 (Florida Dept. of Forestry)



PROJECT NO.: III.5.1

PROJECT NAME: Biological Control of Weeds Workshop

LEADER: Reardon

LEADER ROLE: Coordinate.

PROJECT OBJECTIVE: To provide a forum for coordination and transfer of technology for the biological control of weeds.

BACKGROUND/RATIONALE: The USDA is providing the leadership in expanding the development and application of biological controls to manage native and exotic weed species. The use of natural enemies to manage noxious weeds is becoming a major area of work emphasis for numerous federal, state, and county governmental agencies, as well as for universities and private industry. There is an urgent need to coordinate these efforts and transfer technology into an effective national program.

PRODUCTS/DELIVERY DATES: 1) Publish a proceedings of the workshop; 2) develop cooperative projects on the use of biological controls to manage noxious weeds; and 3) consider establishing this conference as an annual meeting. Delivery date: July 1997.

START/END DATES: FY97

COOPERATORS: George Markin (USDA Forest Service Intermountain Forest and Range Experiment Station); Ernest Delfosse (USDA APHIS - Director, Biological Control Institute); Roy VanDriesche (University of Massachusetts); Ray Carruthers (USDA ARS - National Program Leader for Biological Control); Gary Johnston (USDI National Park Service); Dave Thomas (USDA Forest Service, WO-FHP).

RESOURCE REQUIREMENTS:

Reardon	8 weeks
Funding	\$30,000 (FHTET)

PROJECT NO.: III.5.m

PROJECT NAME: Dyer's Woad Control Demonstration

LEADER: Barry/Reardon

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: To demonstrate the feasibility of controlling large-area infestations of the exotic weed Dyer's woad by aerial application of the native fungus Puccinia thlaspeos, known to infect this weed.

BACKGROUND/RATIONALE: Dyer's woad, a winter annual, biennial, or short-lived perennial introduced to the U.S. from Europe and identified in eight western states, poses a serious threat to forest, rangelands, and pastures in the West due to its ability to dominate plant communities and significantly threaten biodiversity and carrying capacity of the land. A method is needed for large area dissemination of the fungus when the weed is most susceptible and when the micrometeorology is supportive of infection. Procedures need to be developed for producing the fungus spray and for its application by aircraft. The effectiveness of the fungus needs to be demonstrated by replicated field tests.

METHODS: Goal: substantially reduce the spread of Dyer's woad on forest and range lands.

- Objective 1 - Test various concentrations of woad rust spores in different carrying mediums (wet and dry) for viability, mixing characteristic, dosage rates and efficacy. Determine in the field the most effective combinations for use on large areas.
- Objective 2 - Develop a delivery system capable of dispersing a formulation of rust spores over large areas at effective concentrations.
- Objective 3 - Evaluate the effectiveness of the rust and its methodology in reducing woad populations over time.
- Objective 4 - Document results and transfer the technology.

PRODUCTS AND DELIVERY DATES:

A system and procedures for dispersing rust spores to control Dyer's woad.

START/END DATES: FY96/FY01

COOPERATORS: Sherman Thompson and Brad Kropp (Utah State University); Dave Baumgartner and John Guyon (FHP, R4); Wayne Padgett (Wasatch-Cache NF); Jed Dewey (FHP, R1); Dave Thomas (FHP-WO); and the State of Utah.

RESOURCE REQUIREMENTS:

Barry	2 weeks
Reardon	1 week
Funding	\$20,000 (FHTET)
	\$34,000 (R4)
	\$30,000 (Utah State University)
	\$18,000 (Utah Department of Transportation)
	\$20,000 (Utah Department of Agriculture)
	\$60,000 (USDA-CSREES)

PROJECT NO.: III.5.n

PROJECT NAME: Vegetation Management Options for Enhancing Ecosystem Health

LEADER: Barry/Reardon

LEADER ROLE: Coordinate.

PROJECT OBJECTIVE: To demonstrate and evaluate herbicide ground treatment methods for use in supporting species diversity, productivity, ecosystem management, and forest health in middle-aged Douglas-fir forests.

BACKGROUND AND RATIONALE: Vegetation manipulation under existing forest stands is rendered difficult by interception of herbicide droplets by the canopy. Use of granular, soil-active herbicides, such as high rates of imazapyr, would jeopardize overstory residual trees. Thus, we are emphasizing development of low-level application technology of non-residual products that will permit broadcast treatments with hand-held equipment at low volumes necessary for logistical feasibility. Low-volume application technology has been evaluated, calibrated, and combined with practical swath widths, using small drop size for economy and biological effectiveness. Field trials have been initiated, and biodiversity, ecosystem health, and productivity will be evaluated in 1997. This project is part of a larger ecosystem effort funded by the National Biological Service, with additional funds appropriated by the Oregon Legislature. Mike Newton donated personal funds to get this project initiated in 1995.

PRODUCTS AND DELIVERY DATES:

Procedures and recommendations for safe, low-cost effective ground application of herbicides in Pacific Northwest forests, summarized in publishable form by Oregon Forest Research Laboratory by December 1996.

An additional paper, to appear by December 1997, outlining efficacy of low-volume treatments for enhancing understory vegetation composition under thinned stands of Douglas-fir in the Pacific Northwest where management objectives favor multiple canopy layers of coniferous cover.

START/END DATES: FY96/FY98

COOPERATORS: Michael Newton (Oregon State University); Dave Thomas (FHP-WO); Max Ollieu (FHP, R6).

RESOURCE REQUIREMENTS:

Barry	1 week
Reardon	0.5 week
Funding	\$20,000 (FHTET)
	\$45,300 (National Biological Survey)
	\$ 9,500 (State of Oregon)

PROJECT NO: III.6.a

PROJECT NAME: Impacts of Bacillus thuringiensis and Gypsy Moth Defoliation

LEADER: Reardon/Stein

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: To determine the potential long-term impacts of selected insecticides and defoliation on selected non-target terrestrial arthropods, salamanders, and birds associated with broadleaved forests.

BACKGROUND/RATIONALE: The potential regional impacts on non-target species from insecticide application part of the cooperative gypsy moth suppression program was identified as a data gap during the preparation of the AIPM and USDA-EIS. Also, data on cumulative effects of insecticide treatments is required as part of the NEPA documentation to support cooperative suppression programs. These data will provide the basis to modify, if necessary, federal/state/county cooperative suppression programs and eradication projects.

METHODS: Eighteen plots (each 500 acres) were located on the George Washington and Monongahela National Forests (nine on each Forest). Vegetative mapping and non-target monitoring was conducted within each plot. Preparation of NEPA documentation as well as scoping sessions were initiated. Work will be undertaken through a cooperative agreement with West Virginia University.

PRODUCTS/DELIVERY DATES: Provide documentation concerning non-target impacts; if necessary, minimize these impacts by modifying selected aspects of the Federal and State Cooperative Gypsy Moth Suppression program. Delivery date: December 1999.

START/END DATE: FY95/FY01

COOPERATORS: Linda Butler (West Virginia University); Tom Pauley (Marshall University); Robert Cooper (Memphis State University); Gary Bustamante (USDA Forest Service, Monongahela NF); Jeff Witcosky (USDA Forest Service, George Washington NF).

RESOURCE REQUIREMENTS:

Stein	1 week
Funding	\$250,000 (external sources)



PROJECT NO: III.6.b

PROJECT NAME: Development and Application of Semiochemicals for Protection of Pine Seed Crops

LEADER: Stein/Reardon

LEADER ROLE: Facilitate and provide technical coordination.

PROJECT OBJECTIVE: To develop attractants/repellents to determine the impact of Conophthorus behavioral chemicals for protection of pine seed crops, and to assess the non-target effects on other species of cone beetles and bark beetle predators.

BACKGROUND/RATIONALE: Previous studies have identified two behavioral chemicals that have promise for protection of seed crops from damage by cone beetles (Conophthorus ponderosae). Conophthorin is a beetle-produced pheromone that inhibits the response of male beetles to the female-produced pheromone. The other, 4-allylanisole (4-AA), is a tree-produced chemical that functions as a general scolytid repellent. It is necessary to determine whether either of these chemicals (conophthorin or 4-AA) can have undesirable effects on non-target insects or can serve as an attractant for other related species of bark beetles.

METHODS: To assess these factors, we will bait 80 traps in each of four seed orchards: one in California (for C. ponderosa), one in the Uruapan region of Mexico (for C. teocotum), one in south-central Canada (for C. resinosae), and one in the southeastern U.S. (for C. coniperda). At each site, ten traps will be baited with pityol (the female-produced attractive pheromone), ten traps with conophthorin, ten traps with 4-AA, ten traps with conophthorin and 4-AA, ten traps with pityol and conophthorin, ten traps with pityol and 4-AA, ten traps with pityol and conophthorin and 4-AA, and ten traps will go unbaited to test whether the traps themselves attract insects. Targeted species (Conophthorus) will be tallied for each trap and keyed to species level, where possible. Non-target species will be tallied and keyed at least to the genus level.

PRODUCTS/DELIVERY DATES: Results from this study will provide semiochemicals to control cone beetles in seed orchards. Delivery date: December 1999.

START/END DATE: FY97/FY99

COOPERATORS: Gary DeBarr (USDA Forest Service, Southern Research Station); Arturo Del Rio Mora (INIFAP, Mexico); Peter DeGroot (Forestry Canada); Nancy Rappaport (USDA Forest Service, PSW Research Station); Larry Barber (USDA Forest Service, R8-FHP); Larry Binder (USDA Forest Service, R5, Tahoe RD).

RESOURCE REQUIREMENTS:

Stein/Reardon	1 week
Funding	\$32,000 (FHTET)
	\$25,000 (external sources)

PROJECT NO: III.6.c

PROJECT NAME: Development of Pheromones for Cone Worm Population Monitoring and Control

LEADER: Stein/Reardon

LEADER ROLE: Technical coordination.

PROJECT OBJECTIVE: To determine the most efficacious formulations of Dioryctria pheromones to control cone worm populations with minimal impacts on non-target insects.

BACKGROUND/RATIONALE: Recent studies of cone worm pheromone efficacy in western seed orchards suggest that there is some cross-attraction to cone worm pheromone blends, both within the genus Dioryctria and to other, unrelated genera. In order to establish optimum blends for targeted species, it is necessary to deploy these blends in a field setting and to document their effects on both target and non-target species.

METHODS: Six different pheromone blends, representing the most promising blends identified in previous studies for seed orchard pest management, will be deployed in seed orchards in northern California and British Columbia. All arthropods captured in baited traps will be collected and identified to Family level. All Lepidoptera captured in traps will be identified to the Genus level, and those within the family Pupalidae will be subjected to mitochondrial DNA analysis for species identification. (DNA has proven useful in species diagnosis for other Lepidoptera.)

PRODUCTS/DELIVERY DATES: Results from this study will provide tools for monitoring and control of cone worms in seed orchards. Delivery date: December 1999.

START/END DATE: FY97/FY99

COOPERATORS: Gary Grant (Forestry Canada); Geraldine Roux (University of Orleans, France); Nancy Rappaport (USDA Forest Service, PNW Research Station); Dave Schultz (USDA Forest Service, FHP-R5).

RESOURCE REQUIREMENTS:

Stein/Reardon	1 week
Funding	\$20,000 (FHTET)
	\$15,000 (external sources)

PROJECT NO.: III.6.d

PROJECT NAME: Evaluation of Prescribed Burning as a Viable Management Tool for  
Longleaf Pine

LEADER: Stein

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: To determine the impacts of fire on mycorrhizae, root  
pathogenic fungi, and root-feeding beetles on longleaf pine.

BACKGROUND/RATIONALE: Prescribed burning is an essential silvicultural tool in  
the establishment of longleaf pine stands. Although this tree species evolved  
with fire and is dependent upon fire for natural stand establishment and  
maintenance, recent studies indicate a decline in the health and vigor of  
longleaf pine stands. Circumstantial evidence indicates that fungi  
(Leptographium spp. and Heterobasidion annosum), along with root-feeding bark  
beetles, are associated with tree mortality in conjunction with prescribed fire  
regimes.

METHODS: Three longleaf pine sites will be selected: one on the Savannah River  
Site (managed by Region 8) and the other two from longleaf pine sites in Alabama  
or south Georgia. Burned and unburned plots on these sites will be repeated four  
times. Fine root and woody root samples will be obtained at predetermined  
sampling points within the plots. Analysis will determine pathogenic fungal  
populations on roots and insects, root damage, and mycorrhizal fungal biomass.  
Root ingress cores will be installed in plots to evaluate fine root growth due  
to treatments. Data will be analyzed by ANOVA and GLM techniques as appropriate.  
Sampling designs will be reviewed by the station statistician prior to  
implementation.

PRODUCTS/DELIVERY DATES: Information for proactive measures needed for  
successful attainment of management objectives for longleaf pine. Delivery  
date: January 2000.

START/END DATE: FY97/FY99

COOPERATORS: William Otrosina and Susana Sung (USDA Forest Service, Southern  
Research Station-Athens, Ga.); Stan Zarnoch (USDA Forest Service, Southern  
Research Station-Asheville, N.C.); Wayne Berisford (University of Georgia);  
Nolan Hess (USDA Forest Service, R8-FHP); and Charles Walkinshaw (USDA Forest  
Service, ret.).

RESOURCE REQUIREMENTS:

Stein	1 week
Funding	\$55,000 (FHTET)
	\$75,000 (external sources)



PRODUCT NO.: III.6.e

PROJECT NAME: Evaluation of Forest Management Strategies on Ponderosa Pine Productivity

LEADER: Stein

LEADER ROLE: Facilitate.

PROJECT OBJECTIVE: Determine the impact of site disturbances on soil invertebrates and mycorrhizae as indicators of soil health and productivity.

BACKGROUND/RATIONALE: Little is known about soil invertebrate and mycorrhizal communities in forest ecosystems, which are thought to play a crucial role in nutrient cycling and maintenance of productive soils. Although sustainable forest ecosystems depend on the maintenance of soil productivity, the effects that pesticide and fertilizer treatments have on soil invertebrates and mycorrhizae are unknown.

METHODS: Insecticide, herbicide, and fertilizer treatments will be evaluated at an existing long-term study site on soil arthropods that are impacted by site disturbance. Soil arthropod and mycorrhizal communities will be sampled at four intervals throughout the growing season. Organisms will be identified to the family level, and the structure and composition of the arthropod and mycorrhizal communities will be correlated with the biochemical and physical attributes that are currently being measured at the site. The arthropod taxa includes three omnivores and two predatory species: springtails, woodlice, earwigs, antlions, and ground beetles. These groups are widespread in holarctic forests, and represent a broad spectrum of soil-dwelling invertebrates that are good potential indicator species. In addition to these five invertebrate groups, both endomycorrhizal and ectomycorrhizal fungi will also be sampled.

PRODUCTS/DELIVERY DATES: Results will demonstrate the effects of forest management practices on forest soil productivity, and will also provide methodology for similar studies conducted at other sites. Delivery date: December 1998.

START/END DATES: FY97/FY98

COOPERATORS: Robert Powers, Matt Busse, and Nancy Rappaport (USDA Forest Service, PSW Research Station); Gregg DeNitto and Dave Shultz (USDA Forest Service, R5-FHP).

RESOURCE REQUIREMENTS:

Stein	1 week
Funding	\$23,000 (FHTET)
	\$25,000 (external sources)

PROJECT NO.: III.6.f

PROJECT NAME: Archive of Images of Selected Forest Lepidoptera

LEADER: Reardon/Stein

LEADER ROLE: Facilitate

PROJECT OBJECTIVE: To expand the national archive CD ROM release of full-color digital forest-related insects, disease, and management practices images.

BACKGROUND/RATIONALE: Management decisions must be based upon correct identification of organisms, along with relevant biology and life history data. Technical transfer media containing quality color images of unique (e.g., rare and endangered) lepidopterans found in forest environments are limited and not readily accessible. Additionally, as the trend toward delivery and availability of information via electronic techniques become more widespread, the need to have quality images widely available in flexible digital formats will become more important.

METHODS: Images of selected Lepidoptera will come from 1) images used in new or reprinted publications and/or projects, and 2) existing slide sets from within USDA and/or cooperators. The preferred input medium is the original high-quality 35mm slide. All images will be stored in the Eastman Kodak Photo CD format. In addition to an image, the image data system will contain the appropriate taxonomic, biological, distribution, and life history information.

PRODUCTS/DELIVERY DATES: Handbook and CD ROM versions for selected lepidopteran species that are unique to forest ecosystems. Delivery data: December 1998.

START/END DATES: FY97/FY98

COOPERATORS: Keith Douce and David Moorhead (University of Georgia); Wes Nettleton (USDA Forest Service, R-8 FHP); David Wagner (University of Connecticut).

RESOURCE REQUIREMENTS:

Reardon	1 week
Funding	\$20,000 (FHTET)
	\$20,000 (USDA Forest Service, R-8 FH)

PROJECT NO.: III.7.a

PROJECT NAME: Management of NAPIAP

LEADER: Gary Smith

LEADER ROLE: Cooperate, coordinate, facilitate, and provide oversight.

PROJECT OBJECTIVE: To administer the Forest Service segment of the National Agricultural Pesticide Impact Assessment Program (NAPIAP)

BACKGROUND/RATIONALE: Administration of the Forest Service segment of NAPIAP was transferred to FHTET-Morgantown in FY96. This will be a continuing responsibility of the Morgantown Office. Absent the planned Impacts and Pesticide Program Manager (I&PPM) on the Morgantown staff, Gary Smith (R6) was detailed to conduct this activity for FY96 and FY97. During FY97, the continuing need for this detail will be reviewed as the I&PPM has now been hired for Morgantown.

METHODS: FHTET-Morgantown will compile and distribute 1996 project status/final reports and enter the appropriate information into the NAPIAP database. FHTET-M will coordinate with WO-FHP to establish priority data needs for FY97 and develop and send out the call letter for the FY97 project cycle. A review panel will be established and convened to rate the 1997 proposals and provide those ratings and recommendations to the Director, FHP-WO, for final approval and funding. We will work with FHTET-Fort Collins to develop and maintain the NAPIAP database (Project II.3.d). FHTET-M will also develop all correspondence relative to the program, maintain contact with Regional and Area program coordinators to monitor progress, and summarize and report program accomplishments annually. The FHTET-Morgantown Director will serve as the Agency Representative to the USDA-NAPIAP Group.

**PRODUCTS/DELIVERY DATES:**

Call letter for FY97 proposals	August 1996
Establish proposal review panel	December 1996
Funding recommendations to FHP Director	January 1997
Prepare award letters for FHP Director	February 1997
Insert project records in database	Ongoing
FY96 and FY97 accomplishment reports	September 1996/1997
Develop draft plan for coordinating pesticide activities between NAPIAP, TDP, and the FHP Risk Assessment Contract	October 1996
Develop draft technology transfer plan for NAPIAP results	October 1996

START/END DATE: Ongoing

COOPERATORS: Gary Smith (R6); Regional/Area NAPIAP Coordinators; Patrice Janiga/Judy Adams (FHTET-FC).

**RESOURCE REQUIREMENTS:**

Bullard	8 weeks
Smith (R6 Detailer)	15 weeks
Stein	8 weeks
Funding	\$24,300 (FHTET)



PROJECT NO.: III.8.a

PROJECT: Management of Pesticide Programs

LEADER: Stein

LEADER ROLE: Cooperate, coordinate, facilitate, and provide oversight.

PROJECT OBJECTIVES: 1) To administer the FS and FHP pesticide programs in terms of coordinating data acquisition in support of registration and re-registration of biochemical and microbial pesticides of interest to the FS; and 2) to monitor registration status of these pesticides and coordinate with Inter-Regional 4 Group (IR-4) on minor use pesticides of interest to the FS.

BACKGROUND/RATIONALE: Major facets of WO FHP pesticide program coordination and technical pesticides program management responsibilities are now assigned to FHTET-M.

METHODS: Work with FHP-WO, Regional/Area FHP Pesticide Coordinators, FS Research, other federal agencies, states, universities, and others to determine pesticide research needs, and coordinate for development, testing, and application technology development/improvement methodology. Coordinate with EPA and appropriate scientists, industry representatives, etc. for registration, re-registration and Experimental Use Permits for pesticides of interest to the Forest Service. Serve as agency representative to EPA and IR-4.

PRODUCTS/DELIVERY DATES:

Secure registration of MCH	January 1997
Coordinate data acquisition for re-registration of Gypchek, TM-Biocontrol, and Neochek	November 1997
Review registration status of pesticides currently used in forestry	Ongoing
Conduct 1-month detail to US-EPA to meet registration staffs and establish liaison with appropriate EPA units	October 1996

START/END DATES: Ongoing

COOPERATORS: FHP-WO; FHP Regional/Area Pesticide Coordinators; other federal, state, university, and private industry representatives.

RESOURCE REQUIREMENTS:

Bullard	2 weeks
Stein	22 weeks
Funding	\$5,000 (FHTET)









## FHTET-Fort Collins Resource Allocation

PROJECTS			PERSON WEEKS: FEDERAL										
ID	Title	Task Leader	JA	BE	GH	PJ	MM	RM	RP	DR	SS	ES	SW
I.1.a	FHTET Implementation	Eav		12		2							
I.1.b	FHTET-FC Operations	Eav	2	24	30	6	46	4	6	2	4	2	2
I.2.a	FHTET Communications	Janiga	3	3	1	10	1			3	20	3	
I.3.a	Computer System Support	Roschke								12	8		
II.1.a	Airborne/Spaceborne Sensor Eval.	Pywell						8	4				
II.1.b	Support for Acquisition of Imagery	Myhre						16					
II.1.c	Remote Sensing Technology Support	Myhre						10					
II.1.d	DFTM Trap Manufacture and Distrib.	Scrivner									6		
II.2.a	Support for National Reporting Reqs.	Pywell							5				
II.2.b	Support for Off-plot Forest Monitoring	Pywell							14			2	
II.2.c	GIS/Remote Sensing/Data Visualizat'n	Pywell						2	6				
II.2.d	Pest Model Output Display	Pywell	1			5			5	3			
II.3.a	Forest Health Projects and Display	Janiga				5							
II.3.b	PTIPS Database Support	Adams	4										
II.3.c	PURS Database Support and Report	Roschke								4	4		
II.3.d	NAPIAP Database Support	Adams	2			1							
II.4.a	Tech. Development Program Support	Janiga				5							
II.5.a	Support of Insect & Disease Models	Adams	24										
II.5.b	FVS Conference Coordination	Adams	6										
II.5.c	Pest Model Interface Development	Janiga	2			6							2

## Notes:

Staff (Federal)

JA = Judy Adams  
BE = Bov Eav

GH = Georgia Haynes  
PJ = Patrice Janiga  
MM = Margaret Means  
RM = Richard Myhre

RP = Ross Pywell  
DR = David Roschke  
SS = Sally Scrivner  
ES = Eric Smith  
SW = Stephen Williams



## FHTET-Fort Collins Resource Allocation (cont.)

PROJECTS			PERSON WEEKS: FEDERAL										
ID	Title	Task Leader	JA	BE	GH	PJ	MM	RM	RP	DR	SS	ES	SW
II.6.a	Simulate Landscape Processes	Smith										14	
III.6.b	Biometrics Analysis and Support	Smith									4	15	
II.6.c	Values Determination Project	Smith										4	
II.7.a	INFORMS Implementation	Williams				1				4			14
II.7.b	Integration of Tools within INFORMS	Williams											14
II.7.c	Landscape Assessment Methods	Williams							1			1	10
II.8.a	Internet and Intranet Services	Roschke		1						18	4		
III.1.a	SpraySafe Manager-FSCBG	Eav		2									
TOTALS			44	42	31	41	47	40	41	48	50	41	42

**Notes:**

## Staff (Federal)

JA = Judy Adams  
BE = Bov Eav

GH = Georgia Haynes  
PJ = Patrice Janiga  
MM = Margaret Means  
RM = Richard Myhre

RP = Ross Pywell  
DR = David Roschke  
SS = Sally Scrivner  
ES = Eric Smith  
SW = Stephen Williams

## FHTET-Davis Resource Allocation

PROJECTS			PERSON WEEKS: FEDERAL		
ID	Title	Task Leader	JB	PS	NW
I.1.a	FHTET Implementation	Eav	2		
I.1.d	FHTET-Davis Closure	Barry	9	9	9
I.2.a	FHTET Communications	Janiga		3	
III.1.a	Spraysafe-FSCBG DSS	Barry	2		
III.1.b	Field Meteorology Handbook	Barry	2		
III.2.a	Dispersion and Fate of Bt in Forested Canyons	Barry	0.5		
III.2.b	Environmental Fate of BT in Wasatch Mtns, Utah	Barry	1		
III.5.m	Dyer's Woad Control Demonstration	Barry/ Reardon	2		
III.5.n	Vegetation Management Options for Ecosystem Health	Barry/ Reardon	1		
TOTALS			19.5	12	9

**Notes:**

JB = Jack Barry  
 PS = Pat Skyler  
 NW = Nancy Whitmire

## FHTET-Morgantown Resource Allocation

PROJECTS			PERSON WEEKS: FEDERAL				
ID	Title	Task Leader	AB	LC	RR	JS	GS
I.1.a	FHTET Implementation	Bullard	4				
I.1.c	FHTET-Morgantown Operations	Bullard	24	42	4	4	
I.2.a	FHTET Communications	Janiga		1	5		
II.3.c	PURS Database Support and Report	Roschke				3	
III.2.b	Environmental Fate of Bt in Wasatch Mtns, Utah	Barry/ Reardon			1		
III.4.a	QA/QC Standards for Semiochemicals	Reardon			2		
III.4.b	4-AA to Protect Tress from Southern Pine Beetle	Reardon			1		
III.4.c	Develop Semiochemicals for Operational Use	Reardon			2		
III.4.d	Analysis and Fate of Insect Growth Regulators	Reardon			0.5		
III.4.e	Optimize Nucleopolyhedrosis Products	Reardon			4		
III.4.f	Silvicultural Prescriptions for Gypsy Moth - Demo	Reardon			0.5		
III.4.g	Development of Entomophaga Maimaiga for Use	Reardon			2		
III.5.a	Enemy Complex for Hemlock Wooly Adelgid	Reardon			2		
III.5.b	Develop Biocontrols for Mile-a-Minute Weed	Reardon			4		
III.5.c	Impact of Exotic Natural Enemies on Non-targets	Reardon			1		
III.5.d	Biological Control Program for Woodwasp in S.A.	Reardon			1		
III.5.e	IPM Program for Common Pine Shoot Beetle	Reardon			1		

## Notes:

AB = Allan Bullard  
LC = Lisa Cress

RR = Richard Reardon  
JS = Jack Stein  
GS = Gary Smith



## FHTET-Morgantown Resource Allocation (cont.)

PROJECTS			PERSON WEEKS: FEDERAL				
ID	Title	Task Leader	AB	LC	RR	JS	GS
III.5.f	Biological Control of Weeds in the Western U.S.	Reardon			1		
III.5.g	Cooperative Biological Control Projects	Reardon			0.5		
III.5.h	Mycorrhizae to Suppress Root Diseases	Reardon			0.5		
III.5.i	Establish Parasites of Mealybug in PRC	Reardon			0.5		
III.5.j	Natural Enemies of Cypress Aphid in Kenya	Reardon			0.5		
III.5.k	Develop Biocontrols for Managing Cogongrass	Reardon			5		
III.5.l	Biological Control of Weeds Workshop	Reardon			8		
III.5.m	Dyer's Woad Control Demonstration	Barry/ Reardon			1		
III.5.n	Vegetation Management Options for Ecosystem Health	Barry/ Reardon			0.5		
III.6.a	Impacts of Bt and Gypsy Moth Defoliation	Stein				1	
III.6.b	Conophthorus Behavioral Chemicals for Seed Crops	Stein/ Reardon			0.5	0.5	
III.6.c	Development of Pheromones and Assessment of Attract.	Stein/ Reardon			0.5	0.5	
III.6.d	Effect of Prescribed Burning on Nontarget Organisms	Stein				1	
III.6.e	Forest Manatement on Soil Arthropods and Mycorrhizae	Stein				1	
III.6.f	Image Archive of Selected Forest Lepidoptera	Stein/ Reardon			1		
III.7.a	Mangement of NAPIAP	Smith	8			8	15
III.8.a	Management of Pesticides Program	Stein	2			22	
TOTALS			38	43	49.5	41	15

## Notes:

AB = Allan Bullard  
LC = Lisa Cress

RR = Richard Reardon  
JS = Jack Stein  
GS = Gary Smith



## Summary of Costs for Technical Development and Service Projects

Dollars (in thousands)

<b>Task #</b>	<b>Description</b>	<b>FHTET</b>	<b>Other sources</b>
II.	INFORMATION TECHNOLOGY AND ANALYSIS		
II.1.	Data Acquisition		
II.1.a.	Airborne/Spaceborne Sensor Evaluation and Development	41.482	105
II.1.b.	Remote Sensing Support for Acquisition of Imagery	21.724	124
II.1.c.	Remote Sensing Technology Transfer, Training, and Support	15.956	15
II.1.d.	DFTM Trap Manufacture and Distribution	16.9	--
II.2.	Information Analysis and Display		
II.2.a.	Support for National Reporting Requirements	43.86	--
II.2.b.	Support for Off-Plot Forest Health Monitoring	26.531	--
II.2.c.	GIS/Remote Sensing/Data Visualization Applications Support	47.868	--
II.2.d.	Pest Model Output Display	32.616	--
II.3.	Information Management		
II.3.a.	Support for Forest Health Projects and Display	8.073	--
II.3.b.	PTIPS Database Support	49.388	50
II.3.c.	PURS Database Support and Report	6.532	--
II.3.d.	NAPIAP Database Support	12.295	--
II.4.	Special Technology Development Program		
II.4.a.	Technology Development Program Management	7.749	--
II.5.	Modeling		
II.5.a.	Support and Maintenance of Insect and Disease Models	98.870	--
II.5.b.	FVS Conference Coordination	11.030	--
II.5.c.	Pest Model Interface Development	88.394	--
II.6.	Quantitative Methods		
II.6.a.	Methods to Simulate Landscape Processes	55.299	--
II.6.b.	Biometrics Analysis and Support	72.266	--
II.6.c.	Values Determination Project	27.3	28
II.7.	Decision Support Systems		
II.7.a.	INFORMS Implementation	77.689	58
II.7.b.	Integration of Forest Health Tools within INFORMS	43.959	58.5
II.7.c.	Documentation of Landscape Assessment Methods	56.411	20
II.8.	Information Distribution		
II.8.a.	Internet and Intranet Services	52.967	--

### III. TREATMENT TECHNOLOGY

#### III.1. Decision-Support Systems for Pest Control

III.1.a. SpraySafe Manager-Aerial Application Decision Support System	25	--
III.1.b. Field Meteorology Handbook for Resource Managers	1	75

#### III.2. Environmental Fate Studies

III.2.a. Dispersion and Fate of Bt in Forested Canyons	1	5
III.2.b. Environmental Fate of Bt Spores in Wasatch Mountains	25	10

#### III.3. MTDC Forest Health Program

III.3.a. Meteorological Instrumentation Support in FHP Operations	--	10
III.3.b. Spray Drift Mitigation	--	40
III.3.c. Peromone Application Support	--	20
III.3.d. DGPS Aircraft Guidance	--	35
III.3.e. Seed Orchard Sanitation	--	30
III.3.f. Engineering Services	--	25
III.3.g. Model Testing and Evaluation	--	50
III.3.h. Graphical Enhancements and Operational Systems Updates	--	15
III.3.i. FSCBG System and User Group Management	--	30

#### III.4. Biopesticides

III.4.a. QA/QC Standards for Formulations of Semiochemicals	5	--
III.4.b. 4-AA to Protect Individual Trees from Southern Pine Beetle	10	--
III.4.c. Develop Semiochemicals for Operational Use	30	--
III.4.d. Analysis and Environmental Fate of Insect Growth Regulators	10	--
III.4.e. Minimize Nucleopolyhedrosis Products for Operational Use	30	--
III.4.f. Silvicultural Prescriptions for Gypsy Moth-Demonstration	5	--
III.4.g. Development of Entomophaga maimaiga for Operational Use	30	--

#### III.5. Biological Controls

III.5.a. Natural Enemy Complex for Hemlock Woolly Adelgid	75	--
III.5.b. Natural Enemy Complex for Mile-A-Minute Weed	50	--
III.5.c. Impact of Exotic Natural Enemies Released in North America on Non-target Lepidopteran Hosts	20	--
III.5.d. Biological Control Program for Woodwasp in South America	4	--
III.5.e. IPM Program for Pine Shoot Beetle	8	--
III.5.f. Biological Control of Weeds in the Western U.S.	10	--
III.5.g. Cooperative Biological Control Projects	5	--
III.5.h. Mycorrhizae to Suppress Root Diseases on Conifers in Nurseries	10	--
III.5.i. Natural Enemy Complex for Mealybug in China	--	--
III.5.j. Natural Enemies for Cypress Aphid in Kenya	--	5
III.5.k. Develop Biocontrols for Managing Cocongrass	50	10
III.5.l. Biological Control of Weeds Workshop	30	--
III.5.m. Dyer's Woad Control Demonstration	20	182
III.5.n. Vegetation Management Options for Enhancing Ecosystem Health	20	54.8



III.6. Non-Target Impacts		
III.6.a. Impacts of <i>Bt</i> and Gypsy Moth Defoliation	--	250
III.6.b. Development of Semiochemicals for Protection of Pine Seed Crops	32	25
III.6.c. Development of Pheromones for Cone Worm Monitoring and Control	20	15
III.6.d. Evaluation of Prescribed Burning for Longleaf Pine Management	55	75
III.6.e. Evaluation of Forest Management Strategies on Ponderosa Pine Product.	23	25
III.6.f. Archive of Images of Selected Forest Lepidoptera	20	20
III.7. NAPIAP		
III.7.a. Management of NAPIAP	24.3	--
II.8. Management of Pesticides		
II.8.a. Management of Pesticide Program	5	--
Total	1568.459	1465.3

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